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Tracking the Trends in Inventory Management in the Automobile Manufacturing Industry Throughout the Business Cycle

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1. Introduction

Inventory is one of the largest and most important assets a manufacturing business possesses, and the turnover of inventory is one of the principal sources of revenue generation for a company. Inventory decisions directly affect the value of cost of goods sold and consequently play a pivotal role in determining the reported earnings of a company. As a result, a thorough analysis of inventory valuation and related accounts can provide a basis for assessing the financial position of a firm.

The management of inventory and how it can provide insight into firm performance is a topic of interest to shareholders, investors, business owners, and the general public. Firm profits can sometimes be deceptive and costs can be hidden in inventories. Through examination of inventory practices and how they differ over time, it should become easier to judge the stability of a firm and the likelihood that it will perform well in future periods. For example, during an economic downturn, if a firm has high levels of inventory as a result of below average sales, management may write off or write down inventory so that cost of sales for the old inventories will be less in subsequent periods. In this case, firms are incurring a loss in the current period so that their balance sheets will reflect the true values of their inventories, and in turn they will recognize less costs them less in the future when they sell older goods which are diminished in value. Simply put, understanding management preferences and behaviors with respect to inventories allows shareholders and other investors to make decisions based on their expectations of firm performance in response to external factors, such as economic conditions.

Moreover, firms may have different incentives that influence their inventory decisions. Management may benefit from reaching a certain earnings estimate, or may have pressure to show steady growth in income and consistent inventory levels. Understanding these incentives

and the consequent decisions that are made also help to indicate how we should expect firms to respond to various economic and external pressures. This analysis also serves to show which firms are better positioned to deal with such pressures; firms with high inventory turnover and a low likelihood of overvalued inventories on the balance sheet, or firms with low inventory turnover that are likely to write-down inventories during recessions. Stability is an important factor to consider when it comes to deciding on an investment strategy, and such trend analysis may reveal the types of firms that tend to be more stable. If it is found that a firm with high inventory turnover may be more stable and likely to show steady growth in the future, an investor may choose an investment strategy which relies on such firms. Indeed, understanding inventory practices and trends is a valuable skill that helps to indicate the stability and growth prospects of firms, industries, and the economy as a whole.

In this paper, I investigate the trends in inventory levels throughout the business cycle to gain an understanding of the extent to which they measure firm performance throughout the business cycle. I examine whether companies with lean inventories perform better during recessions and recover more quickly in subsequent periods. To perform this analysis, I examine trends based on ratios and measures related to inventory and cost of sales levels. As a basis for comparison, firms with relatively high inventory levels will be observed to test their performance throughout the business cycle. Companies considered to have lean inventories typically have relatively higher inventory turnover, and low inventory periods. Likewise, the firms with comparatively high levels of inventories will have low inventory turnover and longer inventory periods. These measures will also be evaluated with respect to how we would expect them to fluctuate during economic downturns. For example, if the average inventory period of the sample of firms goes up during recession then firms are behaving as they are expected to during this

time. Firms that experience a smaller increase in this measure may be making inventory decisions which are allowing them to outperform their peers. Additionally, to narrow the focus of this analysis, I examine the inventory trends of a single industry. Specifically, I focus on the automobile manufacturing industry, which consists of firms that are primarily using the Last-in, First-out (LIFO) inventory valuation method. While doing this analysis on only one industry limits the scope of the research, it provides a more detailed insight into inventory practices. Given various constraints, a comprehensive analysis of several dissimilar industries and particularly of firms with very different treatments of inventories is unfeasible and unusable for our purposes. Observing inventory trends in the context of firm performance throughout recessionary vs. non-recessionary periods in the automobile manufacturing industry will help to more carefully test the hypothesis and draw conclusions to similar firms and industries. This research can provide insight into methods of financial statement analysis through the lens of inventory management and will shed light on adjustments that firms make in response to economic conditions.

This paper is organized into seven sections. In the next section, I provide background information which includes the factors that affect levels of inventory, methods for inventory management and manipulation, several reasons why the automotive manufacturing industry was an appropriate selection for this study, as well as, a breakdown of the recessionary and non-recessionary periods which will specifically be observed. In section 3, I describe the methodology for my research. Section 4 provides a discussion of how the sample firms were obtained, and how the firms were grouped and ranked. Section 5 discusses the measures that will be used to examine the inventory trends and the advantages and disadvantages of each measure. This section also contains a discussion of which metrics are the most effective in measuring firm

performance, and the reasoning for selecting those as measures of financial success. Section 6 explores how each of the different measures are used and what they can reveal about inventory's impact on firm performance. Section 7 explains the data and analysis that I perform. This section primarily contains graphical analysis of firm performance, and the results of this analysis. Finally, Section 8 presents the conclusions.

2. Background

The value and level of inventories have several determinants. One of these determinants is Gross Domestic Product (GDP) growth, which measures how well the economy is performing each year. When the economy is growing, there are more jobs available, people have more disposable income, are able to purchase more goods, and consequently the sale of consumer products like cars increases. Although there are many factors which drive GDP growth, it can still serve as an indicator for the demand for cars. By collecting GDP data since 1990 from the Bureau of Economic Analysis (BEA) and comparing it to historical auto sales and leasing figures from the Bureau of Transportation Statistics (BTS), I found that the Pearson correlation coefficient between the two sets of data was 0.484. This positive correlation between GDP and auto sales shows that as GDP grows, auto sales grow. The coefficient is relatively low because auto sales are only a very small part of GDP and there are several other determinants. In any case, it is a fair assertion to say that changes in GDP indicate that there will be some changes in overall auto sales.

Other factors which may affect inventory levels include technological advances, environmental factors/ resource availability, and federal laws and regulations. Advances in technology can render products obsolete or outdated because they may provide consumers with less expensive and/or more efficient options. Additionally, these advances may affect the

popularity of older products that will be phased out. For example, advances in renewable energy and alternative sources of power have opened up many avenues for growth in the automotive industry, while simultaneously reducing the demand for gasoline powered cars. Electrically powered cars and hybrid vehicles have become increasingly more popular and much of their sales have come at the expense of the sale of gasoline powered vehicles. This reduction in demand and sales could have resulted in increased inventories for many firms unable to keep sales on pace with their production. Furthermore, environmental factors and resource availability can also have an effect on inventory levels, as they can cause the price of owning certain goods financially and economically costly.

There are several areas where management is required to make decisions to adjust inventory levels from year to year. Inventories are revalued each year based on changes to their fair market worth, and adjustments are made accordingly. Under U.S. Generally Accepted Accounting Principles (GAAP), firms use the lower-of-cost-or-market method of inventory valuation to ensure that inventories are being properly adjusted. When inventory declines in value below its original cost— as a result of, for example, obsolescence, price-level changes, or damaged goods— firms should write-off or write-down the inventory to market and report this loss (Kieso, Weygandt, Warfield 422). Market is defined as replacement cost that should not exceed the net realizable value and should not be less than the net realizable value reduced by an allowance for normal profit margin (ARB 43, Ch 4, St. 6). Management is given some discretion in the valuation of the firm's inventory, as they decide on the timing and quantity of inventory write-downs. Moreover, in addition to purchases and sales of inventory, firms can make adjustments to their inventory figures, and subsequent level of earnings, through LIFO liquidations, accelerated sales at the end of fiscal periods, and adjustments to inventory reserves.

The extent to which firms choose to utilize their discretion to adjust their levels of inventory can have a large impact on the financial standing of the firm.

To understand the degree of inventories' impact on a firms' performance throughout the business cycle, it is important to note the ways in which inventory figures can be influenced by management. Discretionary inventory decisions may correspond to valid responses to the economic climate that results in the gain or loss of inventory value. On the other hand, they may be used opportunistically to inflate earnings figures in some periods, while understating them in others. In the latter instance, the timing and magnitude of write-downs may be exaggerated, leading to earnings management through inventory mismanagement. There are a number of pressures on firms to perform and keep pace with their competitors; the burden to do so is generally placed on management. Therefore, management may make decisions that skew investor perceptions about their true performance in a specific period, so that the overall long term success of the firm looks better. As firms move through the peaks and valleys of the business cycle, they may have incentives to partake in strategies to increase earnings in subsequent years following a downturn in the firm's current financial performance. According to Jim Henry of Bnet.com the theory is seen in practice: "If you're going to take a bath, make it a big bath. Chuck in every piece of bad news you can think of. That way, you get as much bad news as possible out of the way at the same time. Each individual piece of bad news gets less attention than if you announced them one at a time (Henry 1)." Certainly, management may believe that investors will forgive short-sighted losses during an economic downturn in which growth is stalled and sales are already suffering. In such cases, reducing current earnings and trying to recoup losses in future periods may have a more positive long term effect on the firm. On August 1st, 2008, General Motors announced a $15.5 billion net loss for the second quarter of

that year, which included many special items such as a $1.6 billion write-down of off-lease vehicles (Henry 2). The issue with this continued strategy is that if losses are continually incurred and the firm is unable to recover and post profits in future periods it could become insolvent and may be headed towards bankruptcy, as was the case with General Motors in June of 2009. In any case, firms must be careful about the nature, timing, and extent of their inventory management decisions.

Alternatively, firms may be tempted to utilize 'cookie jar reserves' to understate earnings during a booming period so that they can report relatively modest earnings in a recessionary period. While the leeway given to management with respect to inventory management does cause there to be a risk of earnings management, it by no means implies that managerial discretion is being used for the unlawful misrepresentation of the firm's financial statements. In any case, since inventory levels can help determine a firms' ability to withstand economic pressures, an analysis of potential inventory management can help to show how much importance management places on inventory valuation. If a firm consistently appears to be decreasing inventories significantly before an economic downturn, it may be trying to better position itself to endure what it expects to be a period of decreased sales. This could help to show that management values lean inventories when the economy is suffering and demand for their products is down.

For the purposes of this study, I measure firm performance primarily based on selected profitability ratios: return on assets, return on sales, and return on equity. Moreover, I examine how the average performance metrics for lean firms compare to the averages for medium and non-lean firms. By grouping the firms as lean, medium, or non-lean, it becomes easier to observe how inventory practices affect firm performance. This method of testing my hypothesis will

allow me to observe and measure trends, which may lead to the discovery of different factors which could be affecting firm performance.

There are several reasons why the automobile manufacturing industry is worthy of being specifically studied. First, the capital-intensive nature of the industry, rapid changes in preferences and modifications resulting in obsolete inventory, and price decline for products as they are replaced by newer and more appealing models, increases the likelihood and frequency of inventory write-downs for FIFO firms. Therefore, firms in this industry could potentially write-down inventories when they expect the next year to be unfavorable so that they could have more lean levels of inventories during a downturn. It is, however, important to keep in mind that since firms that value their inventory using FIFO carry current costs on their balance sheets, the likelihood of such firms to write down their inventory is inherently larger than firms that carry inventories valued at the old costs and use LIFO. Since inventory write-downs happen as a result of overvalued inventories that are being carried at outdated costs, or from obsolescence, LIFO firms tend to be less susceptible to inventory management in the form of a write-down. In a survey done by the AICPA breaking down the usage of LIFO by industry, 53 percent and 44 percent of surveyed firms in the 'motor vehicles and parts' industry used LIFO in 2006 and 2007 respectively (2007 Accounting Trends and Techniques). Despite the downward trend in LIFO use, a high percentage of firms in this industry have historically been valuing inventories using FIFO and therefore were more prone to having to make a write-down decision. Having said that, several of the major automotive manufacturing firms and specifically the firms that will be examined in this study are multinational or foreign firms that value their inventories using FIFO, making the probability of inventory management decisions higher.

Moreover, the market for automobiles is cyclical and depends upon general economic conditions and consumer spending. If general economic conditions deteriorate, consumers may defer purchasing or leasing new vehicles or opt for used vehicles, which would decrease the total number of new cars sold (General Motors Corp, 2007 Form 10k, 1-143). This increases the need for management to effectively forecast sales and production amounts to keep inventories at a manageable level. As mentioned earlier, fluctuations in the price of fuel also affect consumer preferences and spending. Therefore, the pricing of natural resources and commodities influence the sales and the value of inventory in this industry, since external variables determine how many cars are sold and how many become obsolete inventories or are diminished in value. Since so many external economic factors impact the level of inventories that firms in this industry hold, my hypothesis can be tested using this sample of firms. In other words, if the state of the economy can have such a large impact on the amount of inventory a firm keeps firms that maintain leaner inventories should be better able to handle economic downturns. The automotive industry is highly competitive, and overall manufacturing capacity in the automotive industry exceeds current demand, although it is at a historically high level globally (General Motors Corp, 2007 Form 10k, 1-143). As a result, there may be excess inventories in the industry from slowed growth in sales. Indeed the need to continually assess the value of inventory in such a dynamic economic climate, make this industry an ideal sample to test the validity of the established hypothesis.

The timeline which will be used to investigate the hypothesis will be the previous three recessionary periods dating back to 1981. Using U.S. Census Bureau data, the past three recessions have taken place from March 2001-November 2001, July 1990-March 1991, and July 1981-November 1982 respectively (USCB National Bureau of Economic Research). After the

recession in 1982, the U.S. economy experienced a period of extended growth and prosperity until the early 1990's. Therefore, for the purposes of this study, the trends from November 1982-July 1988 will be examined. Another period of economic boom in the U.S. economy was after the recession of 1990-1991. This period is often referred to as the start of the dot-com boom (USCB National Bureau of Economic Research). Since the economy began another expansion after March 1991, the period that will be used for this study will be March 1991-December 1996. Finally, the period from November 2001 to May 2006 will be used as the final period of economic expansion. My analysis will broadly observe how firms are performing before, during, after these established periods. These well defined boom and bust periods will help to provide context for my research as I compare inventory trends and make assertions their impact on firm performance.

3. Methodology

To test my hypotheses I use a bottom-up approach: I examined the trends in each individual company in my final sample first, and then group companies based on the leanness of their inventory and observed the trends of those groupings. This allowed me to cross reference my firm level trend analysis with my leanness grouping analysis of firm performance, and draw conclusions about how inventory practices affect profitability. I used two metrics to rank each of the firms in each of the groups in terms of how lean their inventories were: Inventory Turnover, Inventory Period. In Appendix A, Figure 1-1 and 1-2 show the inventory turnover and inventory period graphs and charts for the large manufacturing firm group (one of the sub-sets of my sample which I discuss in the next section). Figure 1-11 and 1-12 show the inventory turnover and inventory period graphs and charts for the other sub-set of the general sample, the manufacturer supplier firms. Firms with high inventory turnover over time were ranked high and

concurrently, firms with low inventory period over time were ranked high. The graphs show clear differences in how lean the inventories for each firm were, making it relatively easy to rank them. The performance metrics I used, which I discuss in more detail in the next three sections, were graphed in order to view these trends. In addition I looked at the mean and standard deviations of the metrics for both analyses, to reinforce the conclusions drawn from observing the trends.

These rankings were then used to assign companies into leanness groupings for the second part of my analysis. The firms in each sample set which showed the highest inventory turnovers were placed in the 'lean' group. The firms in each sample set which showed a medium level for their inventory turnover were placed in the 'medium' group. Additionally, firms that showed a consistently low inventory turnover and high inventory period were placed in the 'non-lean' group. The companies with the highest mean inventories also had the highest standard deviations and vice-versa. All of the performance metrics were averaged for all of the firms in each leanness grouping. These measures were then graphed and observational notes were taken on the trends in lean, medium, and non-lean firms. These graphs are presented in Appendix B, Figure 2-1 through 2-6 for the large manufacturing firm sample set. Appendix B, Figure 2-7 through 2-12 display the graphs for the leanness grouping analysis for the manufacturer supplier firm sample set.

By further grouping the firms based on their leanness and averaging the metrics of all the companies within each grouping, I was able to more easily test my hypotheses. Looking at each company individually based on their leanness provides a general understanding of how they performed throughout the past three business cycles; whereas an average of all of the lean firms provides insight into how all lean firms in the sample acted as a whole.

4. The Sample

To gather data for my chosen industry, I collect COMPUSTAT data for firms in the same Standard Industrial Classification (SIC) code. Within the automotive industry, my selected data sample came from SIC Code 3711- the Manufacturing- Motor Vehicles and Car Bodies industry (U.S. Securities Exchange Commission). Within this industry code, I narrowed my sample further by selecting three North American Industry Classification System (NAICS) codes: 336111- Automobile Manufacturing, 336112- Light Truck and Utility Vehicle Manufacturing, 336211- Motor Vehicle Body Manufacturing (NAICS Association). These three are among the five codes that make up the 3711 SIC code. I omitted two groups, the Military Armored Vehicle, Tank, and Tank Component Manufacturing and the Light Truck and Utility Vehicle Manufacturing groups from my sample because the firms that fit into these specific classifications produce different products. Military vehicle and tank sales and inventories do not necessarily fluctuate in the same way as a result of changes in the business cycle as they are driven more by political and global military needs. Firms that were found in the light trucks and utility vehicle NAICS code specialized in only those vehicles and therefore would also not be comparable to the rest of the firms that comprised my sample. The resulting sample had 44 firms under the three selected NAICS codes, containing annual financial data from 1980 to 2008. Each of the firms had differing data ranges depending on how long they had been in existence and how long they had been public entities. Firms that had less than 10 years of usable data were not included in my analysis as they would not have a sufficient amount of data to show trends throughout the business cycle. Eleven total firms ended up being used in my study.

By scanning through the sample of the 11 firms that I decided to focus my research on, I noticed several firms that were suppliers of auto parts and frames for vehicles such as trucks and

motorcycles. Also included in the sample were the large well known auto manufacturers. Since the supplier firms' products are intermediate goods as opposed to the finished goods that the large manufacturer firms sell, they clearly had different inventory practices and had to be segregated for the purposes of this study. Therefore, I split my sample into two groups to get an 'apples to apples' comparison: the large manufacturing firm group, and the manufacturer supplier group. Many of the supplier firms were holding companies, meaning they had majority ownership in several smaller auto part manufacturing companies. There were seven large manufacturing firms: Toyota Motor Corporation, Ford Motor Corporation of Canada, Chrysler Corporation, Motors Liquidation Corporation (formerly General Motors Corporation), Nissan Motor Corporation, Honda Motor Corporation, and Fiat Spa Corporation. There were four manufacturer supplier firms: Monaco Coach Corporation, Supreme Industries Incorporated, Brilliance China Automotive, and BNS Holding Corporation. Although this was a smaller sample group, there was a sufficient amount of annual data provided for each firm that allowed for a good comparison and analysis to be performed.

From COMPUSTAT, I obtained several balance sheet and income statement account data fields for each of the 11 companies. The fields that were chosen were total assets, cost of goods sold, earnings before interest and taxes, inventory, LIFO reserve, net income, total receivables, total revenue (sales), shareholder's equity, and total income tax. These fields were selected because they comprised the ratios which I felt would be the best measures of inventory trends as well as firm performance over time.

Before calculating the ratios, I had to ensure that the financial data that I collected was consistent and comparable for each of the firms. Although it has been long accepted for U.S. GAAP, LIFO has little acceptance internationally and many internationally incorporated or

multinational firms report inventories on a FIFO basis (White 1). Although the usage of LIFO has declined steadily since the late 1980's, many of the U.S. firms in my sample reported on a LIFO basis, and recorded a LIFO reserve (Katz 1). In order to reconcile these differences in inventory, cost of goods sold, and net income, I converted the data for each of the companies to a FIFO basis. LIFO values cost of goods sold according to current costs, and results in a lower before tax income, and an understated inventory with respect to FIFO. In order to adjust inventory numbers across the board, I added the LIFO reserve to each year's inventory figure. To adjust cost of goods sold, I added the change in LIFO reserve from the prior year to each year's COGS value. The adjustment of net income was slightly more complicated because it involved adding back taxes, adding back the difference between the adjusted cost of goods sold and the original COGS figure, as well as, determining the amount of taxes to deduct from the new amount of before tax income. I calculated the tax rate for each firm for each year by dividing the total income tax by the sum of the original net income figure plus the total income tax figure. This rate was deducted to find the final adjusted net income figure after the above changes were made. After making the above changes, I used the adjusted COGS, inventory, and net income figures in calculating the metrics that I based my analysis on.

The next step after calculating my metrics was to graph each one for the large manufacturing group and the manufacturer supplier firms. I had one set of graphs for each of my sample groups. By looking at the trends in the two groups of companies for each measure, I observed which companies performed well and held lean levels of inventories over time.

As mentioned in section 3, I ranked the firms within each group based on their inventory turnover and inventory periods. The large manufacturing firm group ranked as follows from most lean to least lean: Toyota, Ford, Chrysler, Motors Liquidation Corporation, Nissan, Honda, and

Fiat. The manufacturer supplier group ranked as follows: Monaco Coach, Supreme Industries, Brilliance China Automotive, BNS Holding Co. These rankings gave me a basis by which to judge the firms on all of the other metrics. The other metrics that were selected showed firm performance, variability in inventories and cost of goods sold, and potential indications of inventory management at play. I decided that using a trend analysis for these ratios would provide a strong visual representation with which to compare lean vs. less lean firms.

For the second part of my analysis, the firms within each sample set were grouped based on leanness as discussed in section 3. In the large manufacturing sample set, the firms that were in the lean group were Toyota and Ford of Canada. The firms that were in the medium group were Chrysler, Motors Liquidation Corporation, and Nissan, leaving Honda and Fiat Spa as non-lean. In the manufacturer supplier sample set, the firms that were in the lean group were Monaco Coach and Supreme Industries. The firm that was in the medium group was Brilliance China Automotive. The firm that was classified as non-lean was BNS Holding Corporation. Since there were fewer companies in this sample set, only the trends for the lean companies differed from the company-specific analysis that was already performed. In any case, by grouping the firms in terms of leanness I was able to make several observations which helped to show inventory's impact on firm performance.

Moreover, for this part of my study, I reduced the number of metrics to focus on those which I felt best indicated firm performance throughout the business cycle. The metrics which I chose to use for this part of the study (excluding inventory turnover and inventory period) were return on assets, return on sales, return on equity, and gross margin percentage. Since the main objective of my study was to distinguish firm performance for lean vs. non-lean companies over various economic cycles, I felt that focusing on these measures of profitability and efficiency

would be the best means of highlighting differences in the success or failure of the firms in my sample sets.

5. The Metrics

As discussed in sections 3 and 4, I selected several metrics to gauge the leanness of firms as well as firm performance over the past three decades. Additionally, I aimed to observe the trends in these ratios to gain an understanding of how specific firms performed before, during, and after economic recessionary periods, and to what extent their inventory practices were indications of their success or failure. The measures which I picked and used in my analysis were inventory turnover (COGS/inventory), inventory period (365/inventory turnover), return on assets (net income/total assets), return on sales (net income/sales), total asset turnover (sales/assets), return on equity (net income/shareholder's equity), gross margin percentage (gross margin/sales), accounts receivable/sales, and inventory/sales comparisons. These ratios were calculated for each firm for each of their years of data, so that a trend could be observed. They allowed me to place each firm on a common scale and provided a basis for comparison since the firms differed in the size of their operations and sales. They also were effective in showing variability in inventories and firm margins over time, as well as showing potential red flags for inventory management. Therefore, I was able to observe which firms seemed to be making the most drastic adjustments to their inventories, whether it was as a result of write-downs, purchases, or LIFO liquidation. I focused more on the timing of these adjustments, as opposed to the magnitude, since I was attempting to understand management preferences and behaviors in response to variability in economic conditions. For many of my key metrics, both the magnitude and timing of changes over time were taken into consideration. While there are several approaches I could have taken to investigate my hypothesis, I felt the trend analysis using the

group of ratios that I developed was the most effective method, and would not only provide empirical support but presented the data in a visually comprehensible manner.

There are several advantages as well as disadvantages to using a graphical trend analysis of ratios for this study. First, since I am using common size ratios and observing how they fluctuate over time, it is easier to pick out which firms are outperforming or underperforming relative to their peers. Ratio analysis is one of the most powerful tools of financial statement analysis as it helps to tell the whole story of changes in the financial condition of a business. Another positive aspect of this method of testing is that the ratios highlight the factors associated with successful and unsuccessful firms. For example, many of the historically efficient and successful firms may show a high total asset turnover, which would be easy to observe by graphing the ratios. Looking at several ratios at the same time can help to reveal certain things about a firm also. If a firm with a relatively low inventory turnover starts making its inventory leaner over time, and this change corresponds to a steady increase in return on equity, we can make the assertion that as the firm has gotten leaner over time, it has become more efficient and profitable for its stakeholders. This kind of analysis may also shed light on how we should expect firms to perform in the future, since past performance is the greatest indicator of future success. The strategy which I am using for this study is called vertical ratio analysis and is used by financial analysts primarily to highlight key financial changes and trends (Accounting for Management).

Another advantage of my methods is that ratio analysis can help to show how companies are structured differently. Since all of the ratios show one balance sheet or income statement item with respect to how it compares to another balance sheet or income statement item, companies with high levels of inventory relative to sales for example stand out in comparison to firms with

low levels of inventory relative to sales. In this instance, the firm with the high levels of inventory may just keep a larger amount of inventories on hand or have comparatively less sales than the firm with lean inventories. Moreover, through my analysis I am able to observe averages and the standard deviations in each metric to see how they moved over time for each of the firms. This facilitates a side-by-side comparison from which to draw my conclusions.

Some of the disadvantages of using ratio and trend analysis are that ratios are only indicators and they cannot be taken to solely determine the financial position of the business. In other words, ratios can be misleading and financial data is open to manipulation through accounting techniques and discretionary decisions by management. Therefore, it is possible that some of the data presented by a company that is considered to be lean, for example, is not representative of the data for all lean firms. Also, the firms within the automotive industry widely differ in their size and accounting procedures, so a comparison of their ratios may be somewhat skewed. Another disadvantage of the ratio analysis that I have conducted is that it requires that I look at a relatively small sample of firms. In the large manufacturing firm sample set there are seven firms and in the manufacturer supplier firm sample set there are only four firms. Therefore, when averaging the data of a group of firms that are considered to be lean, there is a very small sample size and one anomalous company can throw off the average data for the whole 'lean' group. For the manufacturer supplier firm sample set, only the lean group is comprised of two firms, so the medium and non-lean groups only have one firm to represent those groups. As a result, the analysis is really a firm-level comparison. In the large manufacturing firm sample set, each of the groups has at least two firms that are averaged together to represent the data for each respective group. There is a clear trade off in this instance, because there needs to be a small number of firms when doing a ratio/trend analysis for the sake

of comparability, where as trying to separate firms based on certain properties requires a larger sample of firms. Despite this fact, this study still effectively yields some useful conclusions and observations on the inventory properties of the firms in the automotive industry.

Another factor that is important to consider is the limitations of the statistical methods used in the analysis. Since I use averages, standard deviations, and general trend analysis to draw conclusions, the empirical evidence is not necessarily complete. For example, a firm classified in the lean group may have started out as very lean and become progressively less lean over time. Since I primarily used the mean value of inventory turnover to determine leanness, such a trend is not immediately visible through this analysis. This may help to explain if a firm that is classified as lean also shows a decreased return on equity over time. Through the cross-referencing between the firm-level graphs and the leanness grouping graphs I could observe such trends that were not explicit in the empirical data. Finally, the statistical methods that I use are very simple and do not describe how correlated the data is, or show how certain measures vary in relation to other measures, including factors I omit. Having limited knowledge of other statistical methods of analysis, this study takes more of an observational trend analysis than an empirical one.

Of all of the measures listed above there are a few key measures which indicate firm performance over the selected data range. These measures are the three profitability measures which I used in both the firm-level study and the leanness grouping study: return on assets, return on sales (also known as the net profit ratio), and return on equity. I use these metrics as the basis for determining how well the firms and groups of firms have performed over time. The key component in each of these ratios is net income, which is divided by total assets, sales, and shareholder's equity respectively. Using profitability ratios with a different denominator in each

ratio allows me to see several aspects of the firms and how they are performing in relation to their profits. For example if ROA is decreasing over time and ROE is increasing then the firm's total assets may be increasing relative to net income, while it has become more efficient at turning shareholder's equity into profits. In this instance the firm may still be very lean, but it could have increased in other assets causing inventory as a percentage of total assets to go down. Net incomes are expected to fluctuate throughout the business cycle as firms' margins go down during economic downturns and then expand during boom periods. As a result of this fluctuation throughout the business cycle, we can observe which firms or group of firms are seeing the steepest decreases in profits during recession and the steepest increases in profits during non-recessionary periods. Ultimately the net income (the bottom line) is how firms' financial performance is judged and firms that are better able to maintain steady growth in net income throughout the business cycle are the most successful.

6. How the Metrics Are Used

In this section, I describe each measure of profitability; what they each indicate about firm performance, and how we expect them to fluctuate during the course of a business cycle for lean firms versus non-lean firms.

Inventory turnover is a measure of how efficient a firm is at turning its inventories into sales. This measure is calculated as cost of goods sold/average inventory, so as cost of goods sold increases in comparison to average inventory a firm is able to sell off its inventory at a faster pace. Firms benefit from quickly turning their inventories into sales because they have to pay less carrying costs for their inventory, and face less risk of devaluation of outdated inventories. If inventories become obsolete and are unable to be sold, the firm takes on a loss which impacts its profits and consequently the stock value of the firm. For this reason, I selected inventory

turnover as the primary method of determining how lean the firms in my sample sets are; the lean firms with the high inventory turnover should be expected to show overall better profitability. Firms with low inventory turnover can be considered non-lean and are unable to convert inventories to revenues. If firms that have high inventory turnover show steady decreases in this measure over time they are becoming less lean and are less efficiently converting inventories. On the other hand, if a firm shows a steady increase in this measure, it may have developed new technologies that increased the demand for its products or streamlined its processes so that it has less inventories on hand compared to the sales it has created. If the standard deviation of the inventory turnover for a firm is large it shows that there was a lot of variation and change in this measure over time. In other words, the firm either became leaner over time or became less lean. During recessionary periods, we should expect to see a decrease in the inventory turnover of all firms as sales decline and those unsold goods remain on the balance sheet as inventories. Conversely, we should see either an increase or steadiness in inventory turnover during boom periods, as firms may increase their sales but have the same amount of inventories relative to those sales from increased production.

Inventory period, also known as day sales inventory, indicates the number of days it takes a firm to turn its inventory (including goods that are work in progress, if applicable) into sales. In other words, it is the part of the cash conversion cycle which represents the process of turning raw materials into cash for the firm (Financial Ratios- Investopedia). Since inventory turnover is the main component of this measure, changes in the turnover of inventory should correspond to the inverse reaction from inventory period. During recessionary periods, we should expect to see inventory period for all firms to increase, in line with decreases in inventory turnover as discussed above. The opposite should be true during non-recessionary periods.

Total asset turnover is the amount of sales generated for every dollar's worth of assets. It should behave similarly to inventory turnover over time and lean firms should have high asset turnover, unless their inventory levels are very small compared to its total assets. Non-lean firms would also be less efficient at producing sales from their assets.

Return on equity (ROE), also known as return on net worth, measures a corporation's profitability by revealing how much profit it generates with the money shareholders have invested in it (Financial Ratios- Investopedia). ROE is calculated as net income/ shareholder's equity and it indicates how efficiently a firm generates value for its shareholders through its operations. ROE is comprised of return on assets and leverage ratio (average total assets/ shareholder's equity), so firms that are lean and have higher ROE should also have a high ROA. On the other hand, firms that are not lean and are not as efficient should see lower return on equity in comparison. If ROE is declining over time, a firm might be becoming less lean over time, or inventory as a portion of assets may be decreasing over time. During recessionary periods net income declines and therefore return on equity should decline, with the opposite being true of boom periods. Similar to the other profitability, the trend analysis of ROE explains a lot about the financial position of a firm and the various factors that may have caused its success or failure.

Return on assets (ROA) is an indicator of how profitable a company is relative to its total assets. It is calculated as net income/ average total assets. ROA gives an idea of how efficient management is at using its assets to generate earnings (Financial Ratios- Investopedia). ROA can be further decomposed into return on sales and total asset turnover, so leaner firms with high inventory and asset turnovers should have higher return on sales, and therefore should also have higher return on assets. The higher the return on assets the more efficiently a firm is

operating and the more likely it is to show stability relative to other firms during recessionary periods. During recessionary periods we should expect return on assets to decline, as net income decreases and total assets increases as a result of lost sales that stayed on the balance sheet as inventories. In boom periods, ROA should increase with net income and decreases in inventories. Total assets will be affected differently be each firm depending on how large their inventories are relative to their other assets. Firms whose inventories seem to be declining over time relative to their total assets may have ROAs that are less affected during recessionary periods than other firms, since changes in their inventory will have reduced effects on their profitability.

Return on sales (ROS), also known as net profit ratio, is another profitability measure and is calculated as net income/ sales. ROS provides insight into how much profit is being produced per dollar of sales. Firms may have increases in return on sales by increasing their margins through cost cutting or becoming more efficient through technological advances and streamlining of their processes. Firms with higher return on sales have higher margins and are less affected during recessionary periods than firms with smaller margins. During recessionary periods, we should expect ROS to decrease as sales decreases and net income decreases by more as a result of decreased margins. On the other hand, during boom periods both net income and sales increase causing an overall increase in ROS.

Gross margin percentage is a measure that represents the percent of total sales revenue that the company retains after incurring the direct costs associated with producing the goods and services sold by a company. The higher the percentage, the more the company retains on each dollar of sales to service its other costs and obligations (Financial Ratios- Investopedia). The gross margin percentage indicates how well a company can minimize its costs and achieve higher margins on the sale of its goods. Firms are ultimately judged on their ability to create

profits for their stakeholders, and by eliminating costs to become more efficient and increase their margin they increase the market value of the firm to those stakeholders. Therefore this is an important measure when judging firm performance. During recessionary periods, we expect gross margin percentage to go down as sales decrease and costs increase. Firms that fare relatively better in terms of their gross margin percentage during recessionary periods are able to minimize costs better and find ways to maintain their margins despite external factors.

To analyze inventory management practices I measure Accounts Receivable as a percentage of Sales. This metric can serve as a red flag for practices like channel stuffing, where companies inflate their sales figures in a certain period by forcing more products through its distribution channel than the firm is capable of selling in the market. As a result, receivables spike up in these periods and excess inventories may pile up in subsequent periods. Inflated inventories could have a long term impact on the firm which could be reflected in diminished profits over time. Unlike the other measures, this measure should not see drastic changes during a recessionary period, as sales will go down and accounts receivable will slightly increase since payment will be slower. Any major changes in this measure should be investigated for instances of earnings management through inventory management.

Another measure which serves to point out red flags for cases of inventory management is the change in inventory/ changes in sales. Since changes in inventory are tied to changes in sales, any spikes in this measure show that either discretionary inventory management decisions are being made, or that sales are overstated and the corresponding inventory is not being moved. During recessionary periods we should expect increases in inventories to be in line with decreases in sales unless production is altered in anticipation of the slowdown. Likewise, during boom periods increases in sales are in line with decreases in inventory, so there should not be

much of a difference between the trends in the measure during recessionary versus boom periods. The purpose of observing the trends of such a measure are to highlight specific years in which major inventory management actions were made, and then observe their affect on the firm performance.

The final measure I examine for this study is inventory levels as a percentage of total assets to see if more inventories are being held by firms over time. This measure was primarily intended to be used to cross-reference with other measures in my analysis. For example, if a lean firm showed decreases in return on equity over time, I could observe the trend in inventory/ total assets to see if the prominence of inventory as part of total assets was diminished. If this was the case, then the leanness of the firm would no longer be a significant determinant of firm performance and profitability over time. During recessionary periods, we should expect this measure to increase slightly as inventories increase. However, they may also stay relatively steady as changes in other assets increase along with the increases in inventories. In any case, watching the trends in this measure can be a valuable method of testing to see if inventories are large enough for a specific firm to impact productivity and success throughout the business cycle.

7. Data and Analysis

In this section I breakdown the results of my firm-level and leanness grouping trend analysis for each of my key measures. I will discuss the results for both sample groups; the large manufacturing firm group and the manufacturer supplier group. I focus on inventory turnover, inventory period, return on assets, return on sales, return on equity, and gross margin percentage since these were the measures that were used in both analyses. I also discuss important observations made from the other metrics, however, I do not perform a detailed analysis of each

one. Based on these results I will draw conclusions and assess the validity of my hypotheses in the following section.

Inventory Turnover

Inventory turnover for the seven firms in the large manufacturing firm sub-group clearly differentiated the lean firms from the non-lean firms. Appendix A, Figure 1-1 shows the firm-level analysis of inventory turnover. Toyota and Ford both have inventory turnovers that are much higher than the other firms in the sample throughout the 30 year time period. With mean turnovers of 16.28 and 16.98 respectively, they are clearly the leanest firms in this sample. Chrysler, Nissan, and Motors Liquidation Co (formerly General Motors) comprise the medium group with inventory turnovers of 8.85, 7.15, and 7.32 respectively. Honda and Fiat are the least lean firms with turnovers of 5.64 and 4.08 respectively. When the firms within each grouping are averaged, there is a clear difference in the efficiency of the firms, as shown in Appendix B, Figure 2-1. It is important to note that there is a drop-off in the ITO for the lean firms after 1992, driven by the decreasing inventory turnover of Toyota. While Toyota has become less lean over time, it still has a relatively high inventory turnover compared to other firms, and therefore would still currently be considered lean. Ford on the other hand appeared to become leaner over time and started out with an ITO that would be considered to be medium. As I observe the other measures, Toyota and Ford will be of particular interest since they are considered to be the most efficient at converting inventories to sales, and therefore should be more profitable over time. With respect to the recessionary periods, there only appears to be slight drop-offs in inventory turnover for the medium and lean firms during the three economic downturns. The inventory turnover for non-lean firms stayed relatively steady throughout.

The inventory turnover for the manufacturer supplier firm sub-group was more mixed and there were fewer firms in the sample. Based on the mean inventory turnovers of each of the firms, Supreme Industries and Monaco Coach were the leanest with ITOs of 7.34 and 6.50 respectively. The mean inventory turnover was not much lower for Brilliance China Automotive (5.6), but it was not consistently lean over time so it was classified in the medium group. BNS Holding Co was clearly the least lean with an inventory turnover of 2.13. Appendix B, Figure 2-7 displays the leanness grouping graph and table of inventory turnover, while Appendix A, Figure 1-11 shows the firm-level graph and table. Since many of these firms are holding companies and have different inventory practices than the firms in the large manufacturing group, their leanness may have very different implications with respect to how they perform during the business cycle. With that said, it appears that the ITO for lean, medium, and non-lean firms in the manufacturer supplier group all decline in response to economic recession, especially in the 2000 recession. The non-lean firms also see a spike in 2006 as there was a sudden increase in both COGS and inventory. Since all of the firms have been clearly classified based on their level of leanness, and have shown that they have become slightly less lean during recessionary periods, my analysis from this point will focus on how lean firms perform relative to the medium and non-lean firms.

Inventory Period

Since inventory period is determined by inventory turnover it does not require much additional analysis as it should provide the same conclusions as those drawn for ITO. The mean inventory periods for firms in the large manufacturing group were 26.68, 49.64, and 82.12 for lean, medium, and non-lean firms respectively (Appendix B, Figure 2-2) For the manufacturer supplier firms, the mean inventory periods were 55.72, 74.18, 195.82 for lean, medium, and non-

lean firms respectively (Appendix B, Figure 2-8). The firm-level graphs for both groups can also be found in Appendix A, Figure 1-2 and Figure 1-12. The inventory periods in this group are much larger than those for the large manufacturing firms. This may be because the manufacturer supplier group deals in unfinished goods and parts, and therefore are not sold as often as the finished products that the large manufacturers produce. Since automobiles have relatively large lead times, the parts need to be purchased ahead of time, and therefore may sit in inventories for longer periods of time until manufacturers purchase them when they start production. With respect to recessionary periods, we observe slight increases in inventory period, especially in the 2000 recession, in which the non-lean firms see a spike in this measure (Appendix B, Figure 2-8). Indeed, firms in both sample groups react to recessions the way that we expect them to behave.

Return on Assets

There are several conclusions to be drawn from the trend analysis of return on assets. In the large manufacturing group, the leanness grouping analysis provides mixed results (Appendix B, Figure 2-3). The mean ROA for lean, medium, and non-lean firms are 0.032, -0.0005, and 0.038 respectively. While this analysis shows non-lean firms outperforming lean firms, a look at the firm-level analysis provides some insight as to what may have skewed these averages (Appendix A, Figure 1-3). It appears that Honda is an anomaly for a non-lean firm, as it has an ROA of 0.05 (Toyota, Chrysler, Fiat, Motors Liquidation Co had mean ROAs of 0.047, 0.036, 0.016, and 0.001 respectively) which causes the mean for non-lean firms to be so high. Also, Ford (the second leanest firm) has an ROA of 0.01, which brings down the average ROA of the lean firms in this group. There are several reasons why Honda is classified as non-lean, but is still very profitable. Honda is a very diversified firm, and they have several lines of business. In

addition to manufacturing several types of automobiles, Honda also makes a line of motorcycles, which includes everything from scooters to superbikes, and a line of ATVs and personal watercraft. Honda's power products division makes commercial and residential machinery (lawn mowers, snow blowers), portable generators, and outboard motors (Hoovers.com). The production and sales of all of these other products may have resulted in a lower inventory turnover as a result of the demand and behaviors of consumers in the other industries that they service. Another reason why Honda may actually be deceptively lean is that according to Appendix A, Figure 1-10 Honda's inventory level as a percentage of total assets has diminished from around 35% in 1980 to around 10% in 2008. Essentially, Honda's inventory levels have become a smaller portion of its total assets, causing inventory turnover to increase over time. Therefore, Honda may actually be a lean company disguised as a non-lean firm. Honda's margins cause the firm to be profitable, not its inventory. In this instance, the other non-lean firm, Fiat shows a relatively low ROA, so in my observations of the other measures; I will focus more on the impact of Fiat when looking at the trend analysis specifically for the non-lean firms.

The other thing to note for the trend analysis of ROA in the large manufacturing firm group is that during each of the recessionary periods there is a dip in profitability for each of the lean categories, followed by a steady increase in subsequent years (Appendix B, Figure 2-3). Moreover, as shown in Appendix A, Figure 1-3, Nissan, Honda and Fiat's ROA have all fluctuated slightly over time but have not shown an ability to achieve significant growth relative to their peers following recession. Therefore, as expected, return on assets is affected by economic downturns and firms become less efficient during these periods. The less lean firms are also slower to rebound following recessions.

The ROA data for the manufacturer supplier firms is more consistent with expectations. According to Appendix B, Figure 2-9, the mean ROAs for the lean, medium, and non-lean firms were 0.057, 0.042, and -0.024 respectively. This is in line with the conclusion drawn above. Also in this sample group, profitability declines during recessionary periods, and non-lean firms are the most affected as shown by sharp decreases in ROA in 1980, 1990, and 2000. Therefore, it is clear after observing the trends in ROA that leaner firms are generally more profitable and able to recover from recessionary periods more quickly than their less lean peers.

Return on Sales

Return on sales showed somewhat mixed results on the surface. Much like with ROA, Honda skews the average return on sales for the non-lean firms. As shown by Appendix B, Figure 2-4, the lean, medium, and non-lean average ROS were 0.03, 0.008, and 0.029 respectively. A closer look at the firm-level analysis of ROS (Appendix A, Figure 1-4), shows that Honda does in fact have an abnormally high ROS for a 'non-lean' firm for all of the reasons that were previously discussed. Honda's ROS is 0.036 in comparison to Toyota, the leanest firm, with an ROS of 0.04. Also, Ford appears to have an abnormally low ROS, 0.001, which brings down the mean for lean firms. This causes the ROS for non-lean firms to be inflated in comparison to the lean firms. The other non-lean firm, Fiat, has an ROS of 0.018, which is relatively low and is more in line with what we would expect from a non-lean firm.

Moreover, the lean firms showed the most stability in this profitability measure, with low standard deviations of 0.019 for Toyota, and 0.017 for Ford. All of the other firms had significantly larger standard deviations, showing a lot of variability throughout the business cycle, with one exception. Honda, which should be considered a lean firm, also showed very low variability in ROS with a standard deviation of 0.016. The trend analysis of the leanness

grouping graph shows steep declines in the medium and non-lean firms' ROS during the three recessionary periods, while the lean firms show only a small decrease in this measure during economic downturns. Therefore it appears the profitability of lean firms tend to be less affected by economic downturns than less lean firms.

The ROS comparison for the manufacturer supplier firms also provides mixed results. The mean return on sales for lean, medium, and non-lean firms were 0.018, 0.052, -0.016 respectively (Appendix B, Figure 2-10). The medium group is made up of only Brilliance China Automotive which has an abnormally large return on sales (.052) compared to the lean firms in the sample (Appendix A, Figure 1-14). As a result of the small number of firms in this group, one anomalous firm can affect the averages for a whole grouping. The lean and non-lean groupings' ROS for this sample set are more in line with what we should expect to see for those firms. The variations in the ROS of the firms in this sample set are consistent with the trends found in the large manufacturing group. The standard deviations for the lean, medium, and non-lean firms are 0.04, 0.07, and 0.077 respectively. The lean firms clearly appear to be more stable over time and show smaller decreases in the trend analysis during the three recessionary periods. The medium and non-lean firms are affected the most, and both experience steep declines in profitability during economic downturns, and also show steep increases in subsequent years. Based on the trend analysis performed for the measures so far, leaner firms appear to be more stable and successful according to my metrics throughout the economic cycle.

Asset Turnover

Asset turnover shows one of the 'lean' firms actually becomes less lean over time. By observing the firm-level analysis of asset turnover for the large manufacturing sample set (Appendix A, Figure 2-5), we see that Toyota has a very low mean asset turnover (1.12) when

compared to the other lean firm, Ford (4.01). As was seen in the trend analysis for the inventory turnover, Toyota had steady decreases in that measure over time and therefore it is consistent that its average asset turnover is so low. All of the other firms have asset turnovers that seem consistent with their level of leanness. Moreover, each of the firms showed slight declines in asset turnover during recessionary periods. An interesting thing to note about the trends in asset turnover is that many of the less lean firms were the most stable as shown by standard deviation. Fiat for example had a standard deviation of 0.12, and Nissan's was 0.079. By comparison, Toyota and Ford's standard deviations for their turnovers were 0.4, and 0.54 respectively. This may be because both of the lean firms showed steep declines in turnover during the 30 year span, causing the variance to be high. Firms with high levels of inventories may have simply remained just as efficient at utilizing their assets to generate sales over time.

As shown by the firm level trend analysis of the manufacturer supplier firms (Appendix A, Figure 1-15) the mean asset turnovers for the firms are appropriate for what we should expect to see based on the leanness classifications. The lean firms have a higher asset turnover than the medium and non-lean firms. In terms of variability, the lean firms seem to be the least stable in terms of standard deviation, and are the most affected by fluctuations in the economy. With that said, the non-lean firm in this sample, BNS Holding Co had a very high standard deviation and also showed a lot of variability (0.71 compared to 0.89 for Monaco Coach the leanest of the firms). Since the sample size is so small, it is difficult to draw useful conclusions about the stability of firms in terms of asset turnover throughout the business cycle.

Return on Equity

Return on Equity, my final profitability measure, also yielded mixed results. Appendix A, Figures 1-6 and 1-16 show the firm-level analyses of ROE. Appendix B, Figure 2-5 shows the

leanness grouping trend analysis of ROE for the large manufacturing firms. The mean ROEs for lean, medium, and non-lean firms are 0.06, 0.13, and 0.11 respectively. There are a few reasons why the lean firms have such a comparatively low ROE. First, Ford Motor Co of Canada has a very low return on equity of 0.002, which brings down the mean for the lean group. Ford Motor of Canada was established for the purpose of manufacturing and selling Ford automobiles in Canada that were specialized to meet the needs of the target demographic (Ford Motor Company of Canada). Therefore, the company may have lean inventories but may not have been successful and profitable in those areas. Also, much like it had shown in the analysis for my other measures, Honda was very profitable with an ROE of 0.13 despite being classified as 'non-lean' firm. Were Honda classified as a lean firm, the ROE for the lean firms would be much higher, and ROE would be much lower for the non-lean group because Fiat, the other non-lean firm, had a low ROE of 0.056. Moreover, Motors Liquidation Co had the highest return on equity of all of the firms in this sample (0.14), which made the average for the medium group so high. Since GM was such a diversified company with several different product lines its inventory turnover, which was used to classify it as a medium firm, may have been misleading as it is possible that some of its product lines caused overall inventories to increase and reduce its ITO. Therefore, General Motors, like Honda, could be a lean firm disguised as a non-lean firm which is very profitable.

In terms of variability in profitability, General Motors and Chrysler fluctuated the most throughout the three recessionary periods, with standard deviations of 0.48 and 0.99 respectively. Fiat, the least lean of the firms, declined the most during the 2000 recession, although it remained relatively steady through the other 2 recessions. Toyota, the leanest of the firms seemed to be the least affected by economic downturns, and its ROE had a standard deviation of 0.047. Honda, which can also be a considered a lean firm, also showed very little variability and

had a standard deviation of 0.068. This indicates that lean firms are less affected by external factors and tend to remain profitable over time.

DuPont Analysis

I performed a DuPont analysis for the large manufacturing firms to investigate the trends in return on equity and its components (Appendix C, Figure 3-1 to 3-3). Since return on sales, total asset turnover, and leverage make up ROE, we observe the same trends in the DuPont analysis as in the trend analysis of the other measures; the difference in the trends is caused by the leverage ratio (Total Assets/ Shareholder's Equity). Leaner firms also tended to be less levered as can be seen in the table for Figure 3-1. It is important to note that there was more variability and more spikes in the leverage ratio data for the less lean firms which resulted in skewed ROE data. Moreover, as can be seen in all of the graphs, the second biggest driving factor behind ROE is total asset turnover. As discussed earlier, the lean firms had the higher asset turnover over time, and therefore also should have showed higher ROE. However, as was the case through much of this study, there were a few factors and anomalous behaviors by certain firms which resulted in mixed results. The differing data ranges for the lean firms caused the averages for the years following 1995 to be very low for asset turnover since Ford data ended during that year and Toyota became less lean throughout the 1990s. Another factor to consider is that Honda acted like a lean firm throughout the study, and therefore the mean data for the non-lean firms was highly skewed. Excluding these observations, the trends appear to be consistent with what my expectations were as outlined in section 6: lean firms and firms that act as lean firms tend to be more profitable over time, and are not as affected by external factors as shown by the analysis of the standard deviations.

The leanness grouping for the manufacturer supplier firms made the trends more apparent. The mean ROEs for the lean, medium, and non-lean groups were 0.12, 0.10, and -0.04 respectively. In other words, the leaner the firm the more profitable it was for its stakeholders. Additionally, the variability and impact of recessions on the firms increased as the firms became less lean. Appendix B, Figure 2-11 shows that non-lean firms' ROEs fluctuate the most during recessions, especially in 2000. These firms also tended to rebound the most in subsequent years but were unable to sustain growth. The lean and medium firms, on the other hand, remained steady over time and did not see any steep declines in profitability. The trends in ROE for this sample set support the main hypothesis and reflect on the benefits of keeping inventories lean in the automotive manufacturing industry.

Gross Margin

The leanness grouping analysis of gross margin for the large manufacturing firm group (Appendix B, Figure 2-6) shows that lean firms became more efficient and increased their margins over time with very few declines during recessions. While the average gross margin percentage is lower for the lean firms (0.18 as compared to 0.21 and 0.26 for the medium and non-lean firms respectively), the lean trends do not show significant effects when focusing on the three recessions. As shown by the non-lean firm trend, there is a significant drop-off in the margin during the 1990 recession, which creeps back up and then declines again during the 2000 recession. While this is not reflected in the average and standard deviation figures, the trend analysis is consistent with the main hypothesis. Taking a closer look at the firm-level trend analysis shows similar trends: the lean firms (and honorary lean firms like Honda) show steady growth in margins over time and very small declines during the recessions. On the other hand, Fiat has steep declines during both the 1990 and 2000 recessions. General Motors, one of the

companies considered to be among the least lean, saw large drops in margin following the 1980 and 1990 recessions.

By looking at the leanness grouping trend analysis for the manufacturer supplier subset of firms (Appendix B, Figure 2-12), the lean firms actually show steady decreases in gross margin over time. The firm-level analysis for the manufacturer supplier group is in Appendix A, Figure 1-17. The non-lean trend shows steady growth over time until the recession in 2000, when the margins plummet and start rebounding again in 2005. The medium firms also show this decline in margins after 2000. Although I focused on the mean and standard deviation figures for all of my other measures, a pure trend analysis was the most effective for this metric since the trend lines showed a clear tendency for medium and non-lean firms to react poorly to recession. The averages and standard deviations were misleading and did not truly reflect on the behaviors of the various firms and firm groupings. The less lean firms do not appear to have been able to cut costs and maintain margins as effectively as the lean firms and therefore struggled when the economy floundered.

Accounts Receivable/ Sales

One of the 'red flag' metrics, Accounts Receivable/ Sales, is used to identify instances in which practices such as channel stuffing may have occurred. For the large manufacturing sample the trends did not show many obvious examples of earnings management, although there was a large drop in this measure during 2006 for General Motors (Appendix A, Figure 1-8). Part of the reason for this could be the loss in sales and consumer demand for GM products, resulting in significant changes in buying patterns such as buying on account. In fact in 2006, GM's market share was reduced to 26% (CNN Money). In addition, Chrysler showed a sharp increase in this measure during 1987 and then a steep decline again following the recession of 1990. While this

could be an instance of earnings management through inflated sales pushed through as receivables, this measure alone is not enough to warrant concern as there could be external reasons for these increases. It is important to note that sales did increase from $26,276,000 to $35,472,000 between 1986 and 1987. As was shown throughout the study, this spike in receivables did not ultimately significantly affect firm performance during that period and did not required any further investigation.

For the manufacturer supplier sample set, BNS Holding Co and Brilliance China Automotive showed several spikes in their receivables as compared to sales (Appendix A, Figure 1-18). The fact that these firms were the medium and non-lean firms which had displayed a tendency to have reduced profitability during recession supports the assertion that they may have been aggressive in pushing sales to boost sales and earnings figures. BNS Holding Co has a spike in receivables during 1991, immediately following the recessionary period, and then again in 2001 following the next recession. Brilliance China Automotive's receivables fluctuated more over time, however it appeared to have spikes at the same times that BNS Holding Co did. Although this measure by no means serves as evidence of earnings management, it does highlight potential instances of discretionary actions. As was the case with Chrysler, these firms did not display any unusual or outrageous earnings spikes during these periods so the earnings data and trends that were analyzed up to this point appear to reflect appropriately on the financial position of the firms.

Change in inventory/ Change in Sales

For the change in inventory/ change in sales comparison, I aimed to find other instances of potential inventory management. For both sample sets, although there were spikes in the data from write-downs or write-offs in 1995, 2003 and 2005, the overall trends did not show any red

flags (Appendix A, Figure 1-9 and Figure 1-19). Honda and General Motors each had large declines in inventory as compared to the change in sales, but this only occurred during economic boom periods, and there were only three instances total. In the manufacturer supplier sample set, BNS Holding Co and Supreme each had a few spikes in inventory changes as compared to changes in sales; however they were primarily positive changes and could have been caused by purchasing of more inventories or through acquisitions. Overall, the 'red flag' measures did not point out any significant cases of mismanagement, and therefore we can assume that the data used in this study is reflective of true firm performance.

My final measure during this study was observing the changes in the level of inventory as a portion of total assets for all of the companies in my study. This was done on a firm-level basis and is shown in Appendix A, Figure 1-10 and Figure 1-20. For the firms in the large manufacturing group, there appears to be a convergence and a decrease in inventory presence in total assets over time. As shown by the large variances between the high and low inventory/total assets metric, and the fact that many of the low figures for this measure come in recent years, there appears to have been a drop in inventories across the board. This may indicate that as firms have become more efficient and used processes such as just-in-time inventory, the leanness of their inventories have become less important with respect to their performance over the business cycle.

For the manufacturer supplier group, the trend lines also seem to converge, however there is no clear decline in the presence of inventory in total assets (Appendix A, Figure 1-20). This may be because these companies are suppliers of intermediate goods or holding companies of smaller suppliers and therefore their inventories have not seen declines over time as firms have gotten more efficient. It is also important to note that BNS Holding Co, which started out as the

least lean of the companies ended up with relatively smaller inventories as a percentage of total assets when compared to the other firms. Brilliance China Automotive maintained small levels of inventory throughout the 30 year period, but seems to be showing an increase in inventory in recent years. Certainly, it is difficult to draw the same conclusions for both sample sets as a result of the differing inventory practices as well as the different sizes and functions of the firms. This shows that while my small samples may indicate certain trends in the auto industry, the conclusions that I have drawn cannot be extrapolated to all industries, as they may not be appropriate based on the size, functionality, or the inventory practices of the firm.

8. Conclusion

Before discussing these conclusions, it is important to differentiate the conclusions that I draw for the large manufacturing firm sample group from the ones that I draw from the manufacturer supplier sample group. As mentioned earlier, the firms in each of these groups have very different structures and therefore cannot be judged in the same manner. Therefore, some of my observations may be contradictory and require multiple conclusions. Another important factor to consider is that much of my analysis is based on averages and standard deviations which do not account for changes in trends such as firms that have lean ITO averages but have become non-lean over time. As a result, I discuss the trend lines in my graphical analysis to bridge the gap caused by such shortcomings of this research methodology.

Although I used several different types of measures, my primary purpose was monitoring firm performance throughout the business cycle for lean, medium, and non-lean firms. As a result, the conclusions I draw are based on the observations from my trend analysis of the profitability measures, since these are the measures that I have deemed to be most important in reflecting firm performance.

The results of my return on sales for the large manufacturing firms showed that lean firms were less affected by economic downturns as shown by the lack of variability in the lean firms during the recessionary periods. Moreover, for most of the study Honda was considered an honorary lean firm because its many product lines brought its ITO down to a non-lean level, but it showed all of the characteristics of a lean firm. This highlights the fact that although inventory turnover is a way of measuring how efficient a firm is at turning inventory into sales, it may not reflect how lean the firm actually is. The same can be said about many of the measures which are used, as they are not always consistent among the firms in each leanness grouping. Of the lean firms, Toyota and Honda appeared to have high mean ROS, and did not have steep declines when the economy declined. Ford had an abnormally low ROS, but the trend analysis supported my hypothesis that lean firms perform better throughout the business cycle and react better during recessionary periods. In the manufacturer supplier group, the lean and non-lean groups also showed trends that were in line with the above conclusion. Certainly, using ROS as an indicator for firm success throughout the business cycle reinforces the benefits of having lean inventories.

In terms of ROA, the trend analysis of both sample sets shows that leaner firms are generally more profitable and able to recover from recessionary periods more quickly than their less lean peers. The statistical data in the tables provided mixed results for most of my profitability ratios; however a look at the firm-level trend analysis and a look at trend lines during the recessionary periods allowed me to make clear observations from which to draw conclusions. While all firms experienced decreases in profitability during the three economic downturns, lean firms appeared to be the least affected and also rebounded more quickly from

any drop-off. This provides further reassurance that lean firms experience better performance over time, consistent with my hypothesis.

ROE analysis paints a similar picture; however, there were several firms which acted abnormally for the leanness classification they were in. General Motors had a very high mean ROE, while Ford Motor of Canada had an abnormally low ROE considering that it was a lean firm. Toyota and Honda, both considered to be lean firms, also had high ROE's. The medium firms such as Chrysler and GM showed the most variability during the recessionary periods, while the least lean firm, Fiat, stayed steady for most of the study with the exception of the 2000 recession when its ROE declined. The leanest firms, Toyota and Honda, both had very little variability and did not see major losses during recessions. These mixed results made it difficult to draw the clear conclusions I did with the other two profitability measures, however, the very lean firms showed high ROE's while the very non-lean firms showed low ROE's. The manufacturer supplier sample set clearly showed lean firms were more profitable over time than their less lean counterparts. Consequently, this trend analysis supports my main conclusion. Some of my other measures showed differing trends for the large manufacturing firms as compared to the manufacturer supplier firms, however, in terms of my profitability (firm performance) metrics, I was able to draw the same conclusions, consistent with my hypothesis.

Based on the trend and ratio analysis performed in this study, I conclude that firms that have lean inventories in the automotive manufacturing industry, including both large manufacturing companies and suppliers of parts for the manufacturers, are better positioned to withstand economic pressures than non-lean firms. While firms have become more efficient over time and inventories have become a smaller part of their total assets on the balance sheets, inventory turnover is still a key indicator of their operational efficiency. Therefore, their

inventory leanness seems to be associated with lower costs, and allows them to remain efficient even when economic pressures drive demand and sales down. On the other hand, some firms like Ford Motor Company of Canada may be operationally efficient and have very lean inventories, but have comparatively low returns for their stakeholders. Such firms may simply have a poor or unpopular product which does not generate high returns, despite the operational efficiency within the firm. Indeed, while having lean inventories does by no means guarantee firm success over time, it allows successful firms to continue to perform well and endure economic crises.

APPENDIX A

Large Manufacturing Group- Firm-level Comparison

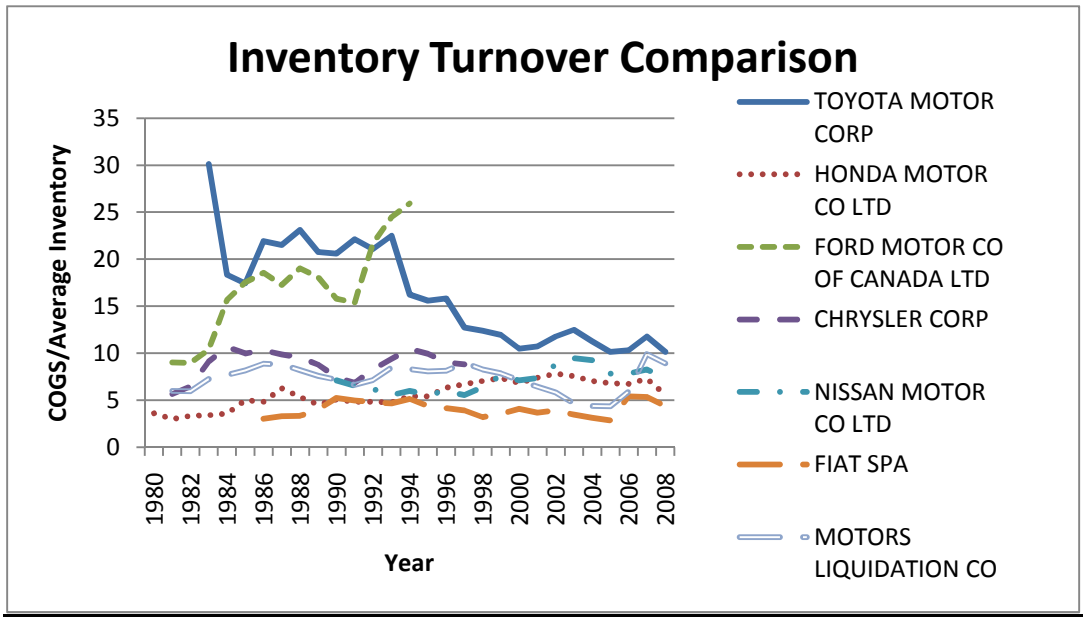

Figure 1-1: Inventory Turnover comparison for large automotive manufacturing firms.

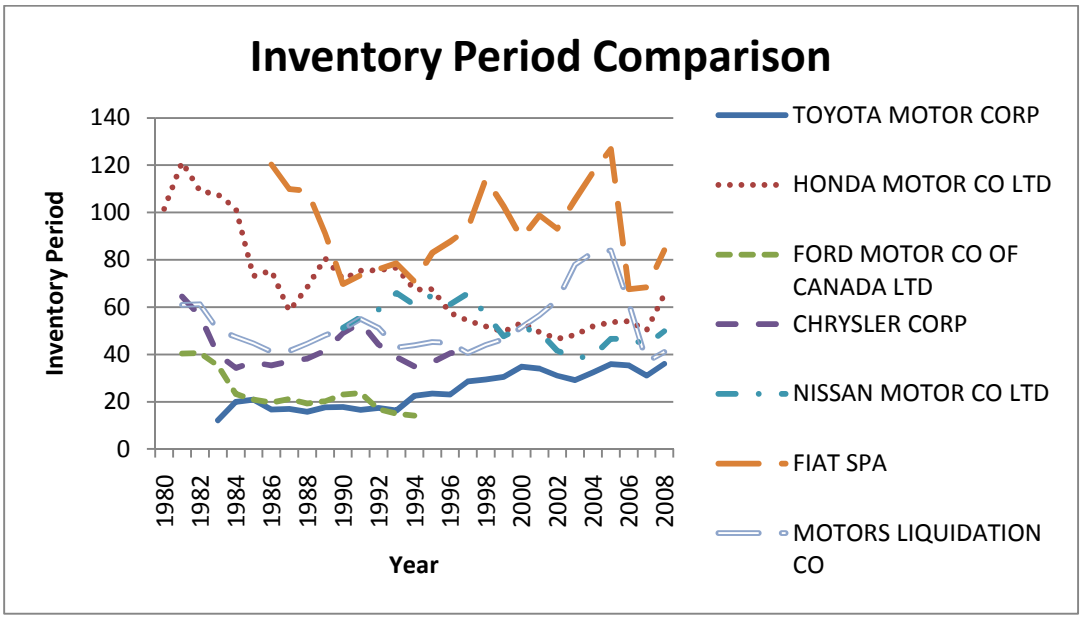

Figure 1-2: Inventory Period comparison for large automotive manufacturing firms.

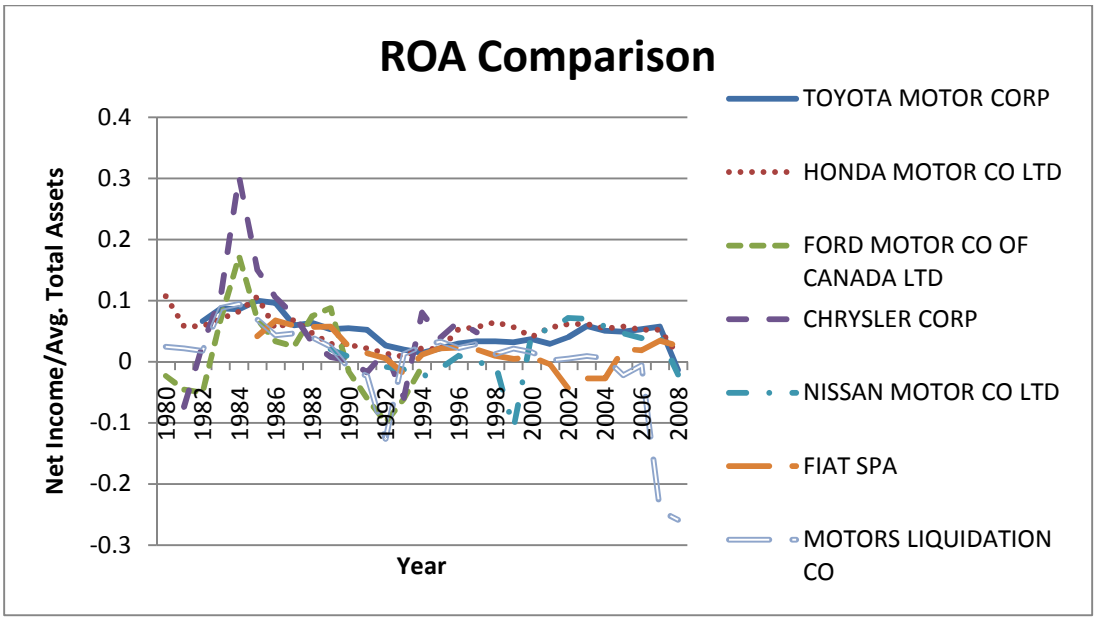

Figure 1-3: Return on Assets comparison for large automotive manufacturing firms.

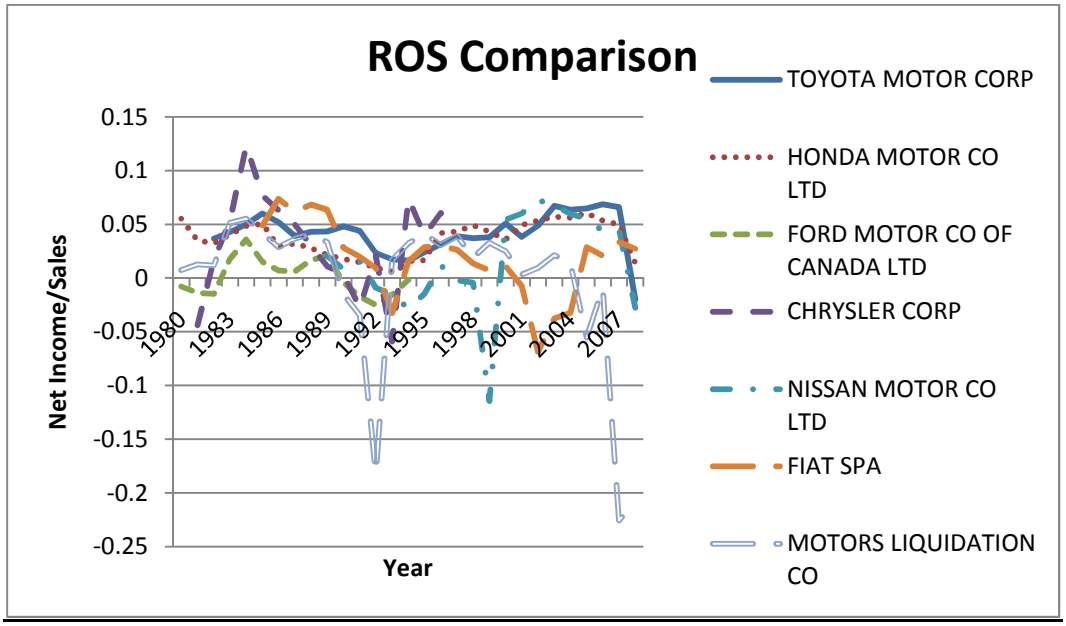

Figure 1-4: Return on Sales comparison for large automotive manufacturing firms.

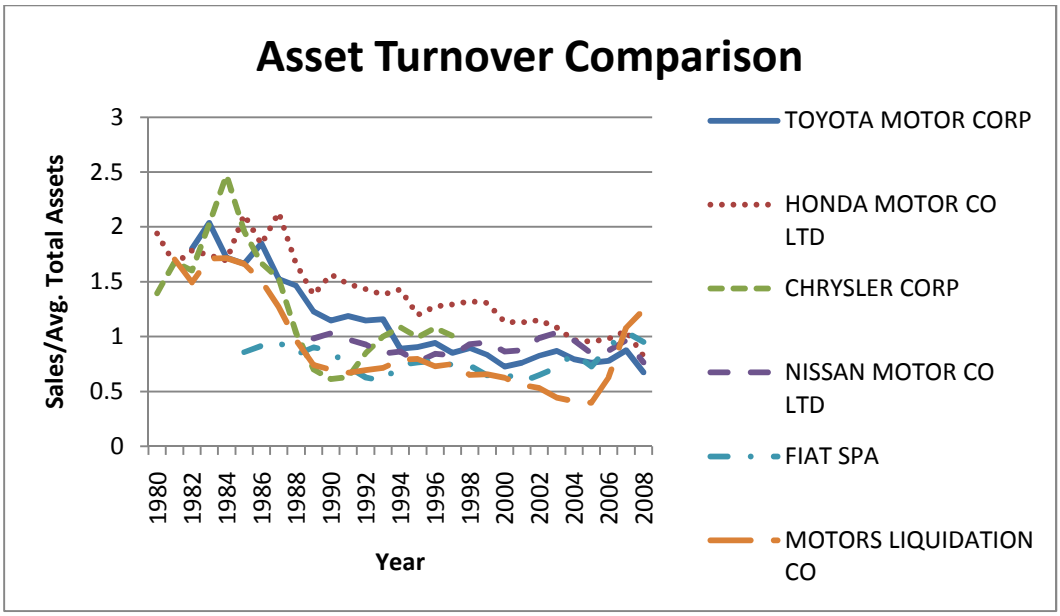

Figure 1-5: Total Asset Turnover comparison for large automotive manufacturing firms.

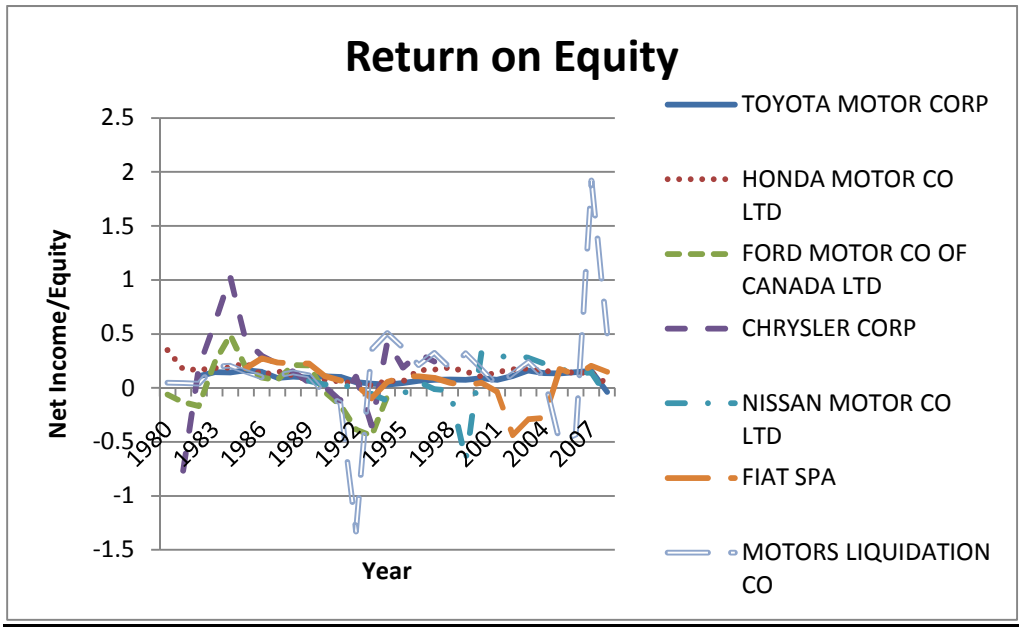

Figure 1-6: Return on Equity comparison for large automotive manufacturing firms.

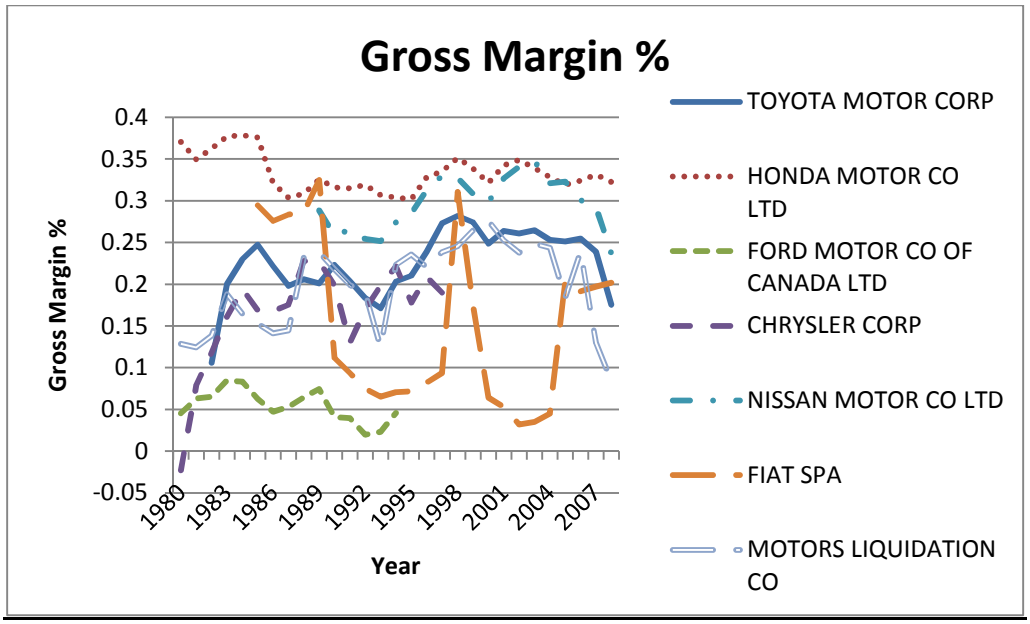

Figure 1-7: Gross Margin % comparison for large automotive manufacturing firms.

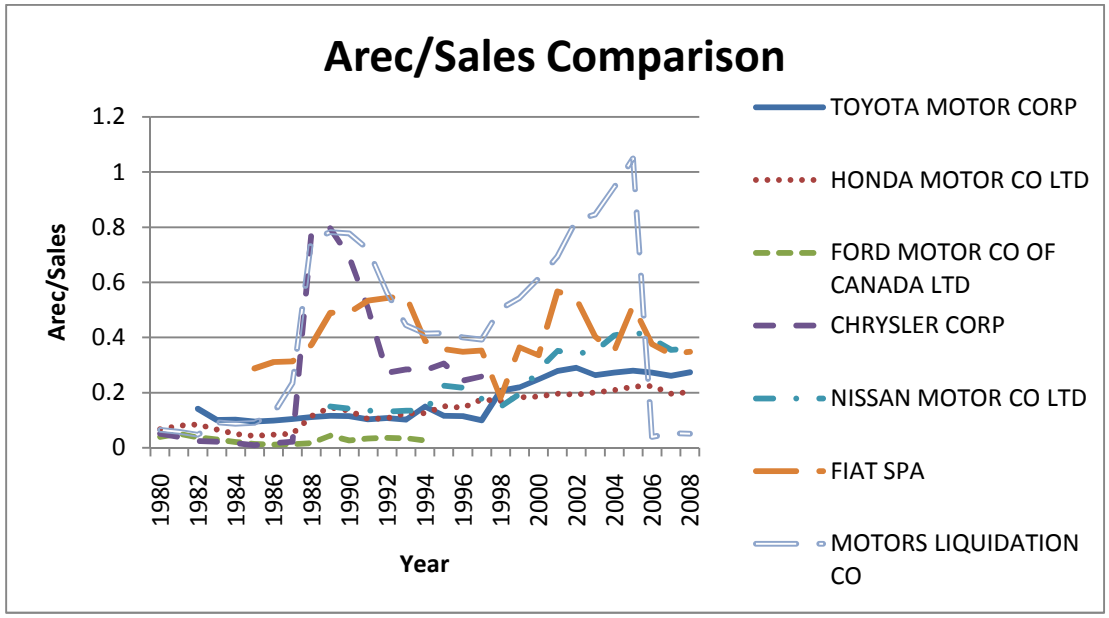

Figure 1-8: Accounts Receivable/Sales Comparison for large automotive manufacturing firms.

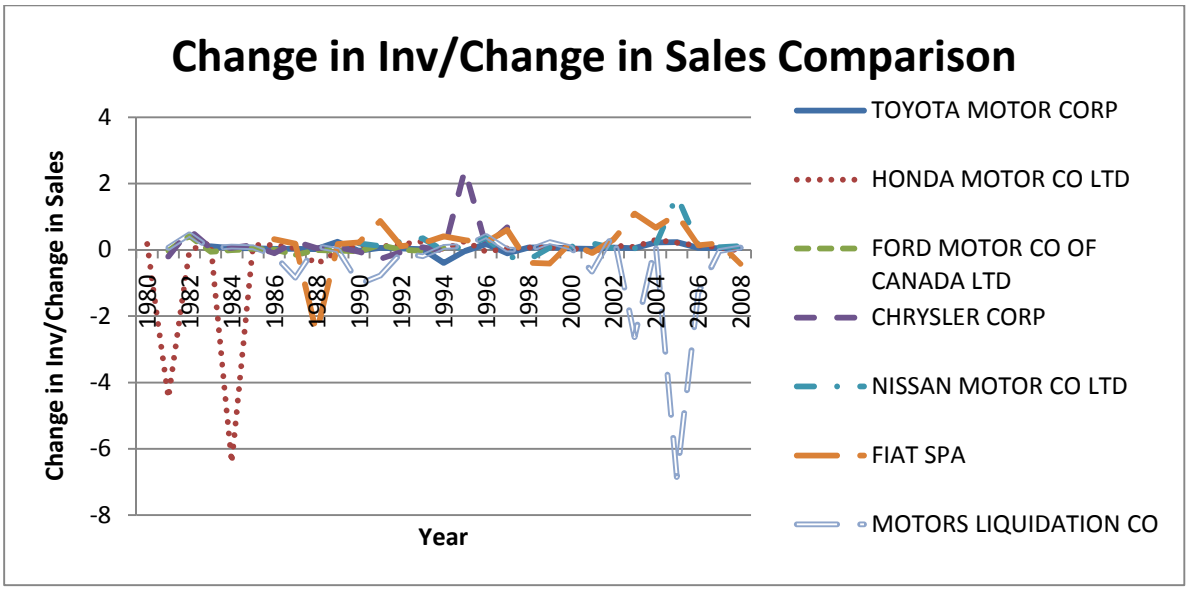

Figure 1-9: Change in Inventory/Change in Sales comparison for large automotive manufacturing firms.

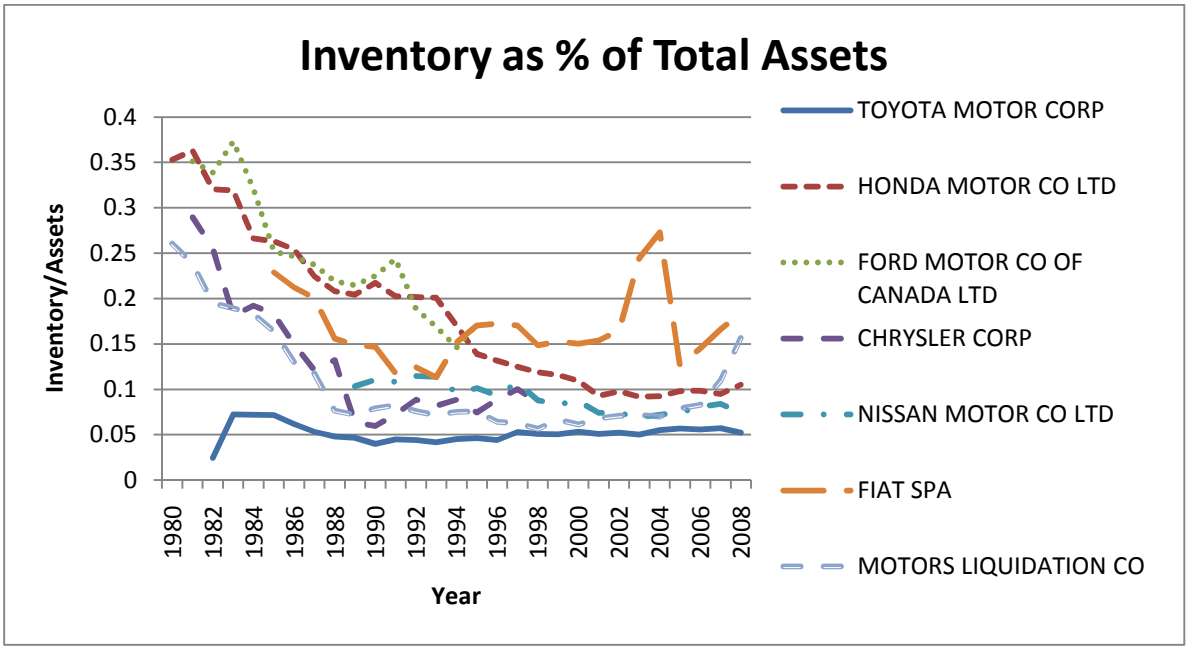

Figure 1-10: Inventory as a percentage of total assets for Large Manufacturing firms.

Manufacturer Supplier Group- Firm-level Comparison

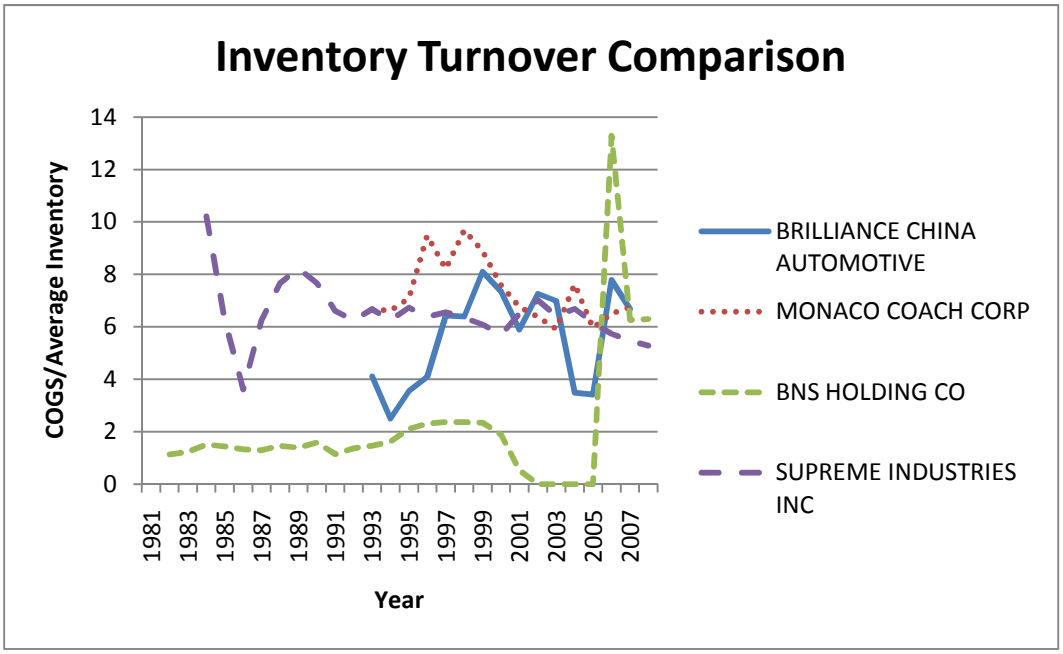

Figure 1-11: Inventory Turnover comparison for manufacturer supplier firms.

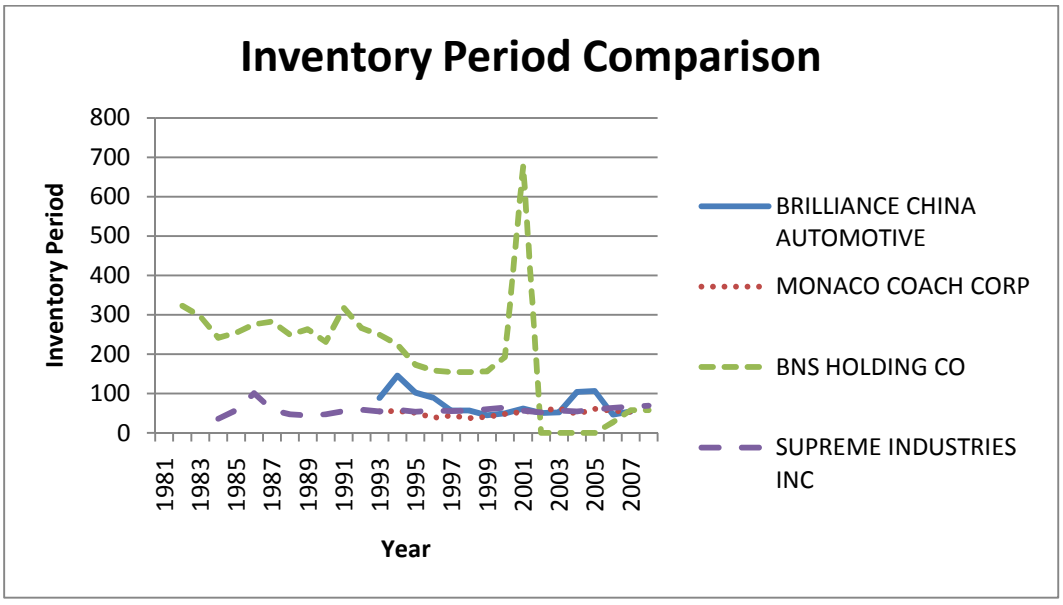

Figure 1-12: Inventory Period comparison for manufacturer supplier firms.

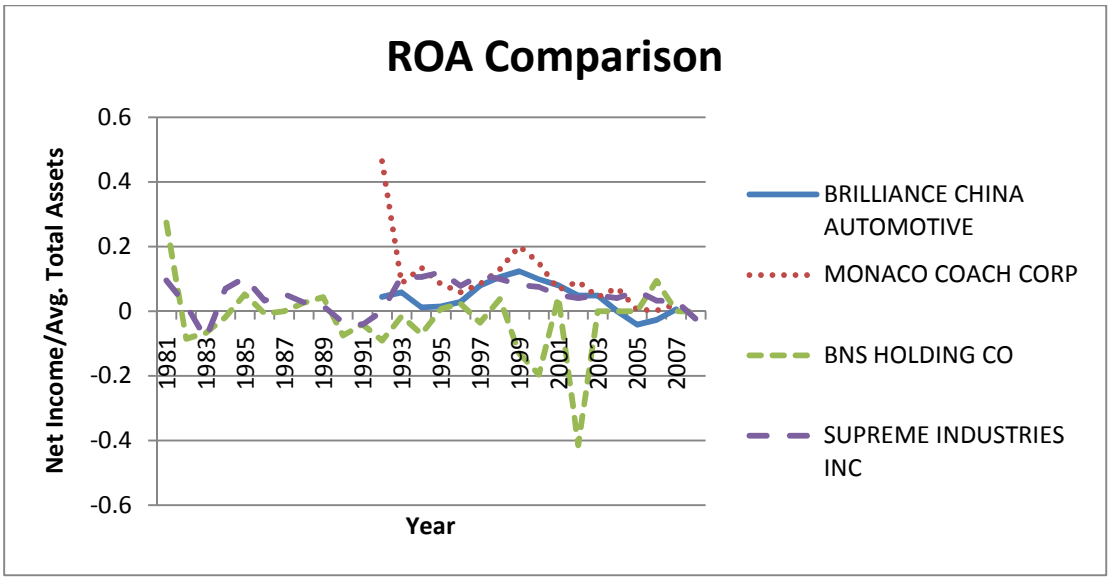

Figure 1-13: Return on Assets comparison for manufacturer supplier firms.

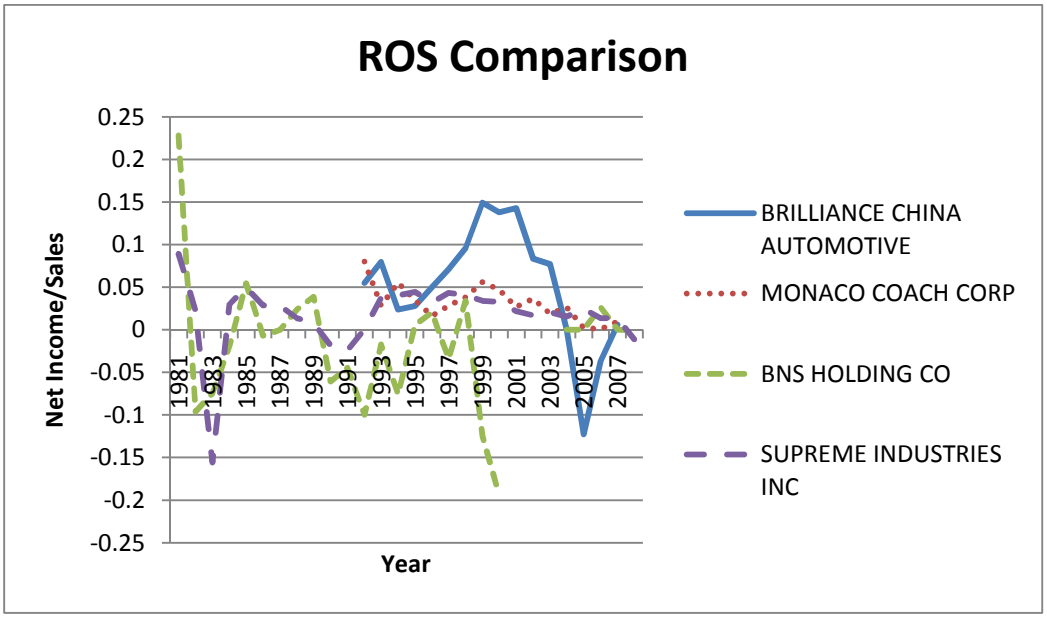

Figure 1-14: Return on Sales comparison for manufacturer supplier firms.

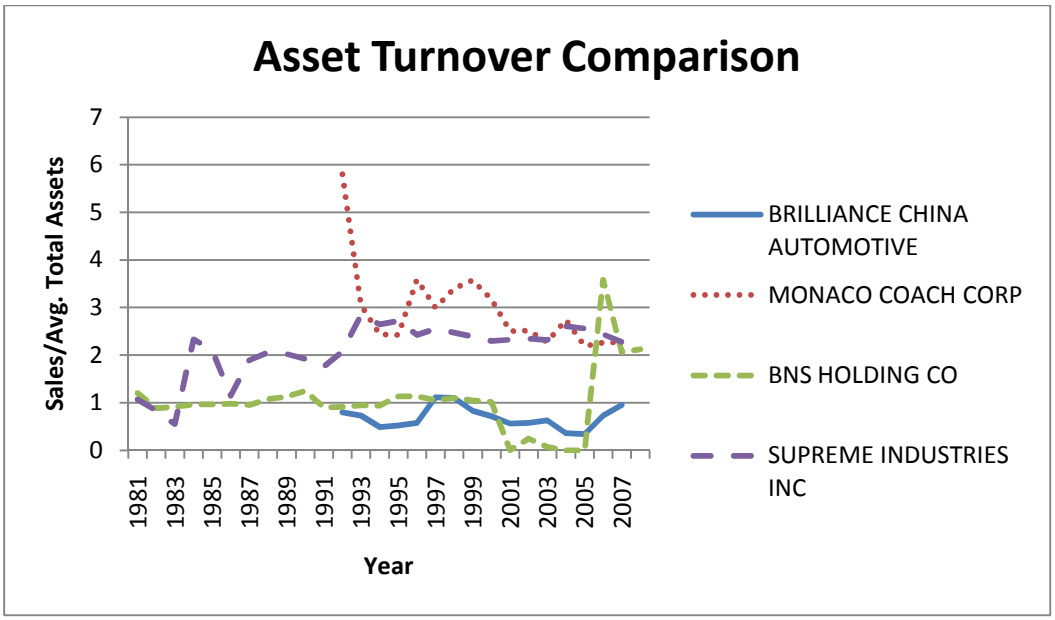

Figure 1-15: Total Asset Turnover comparison for manufacturer supplier firms.

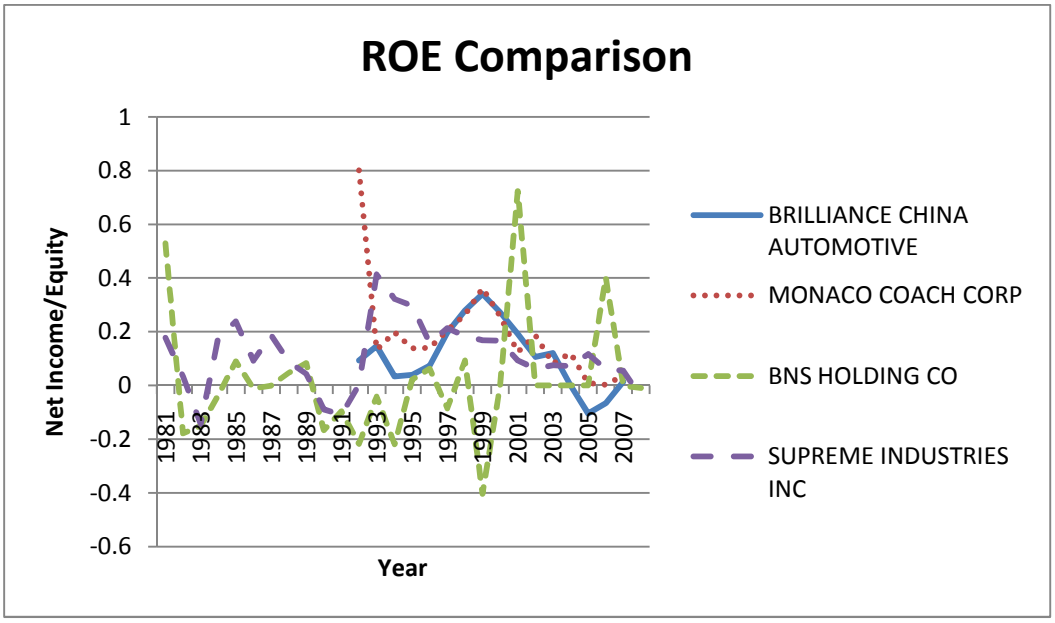

Figure 1-16: Return on Equity comparison for manufacturer supplier firms.

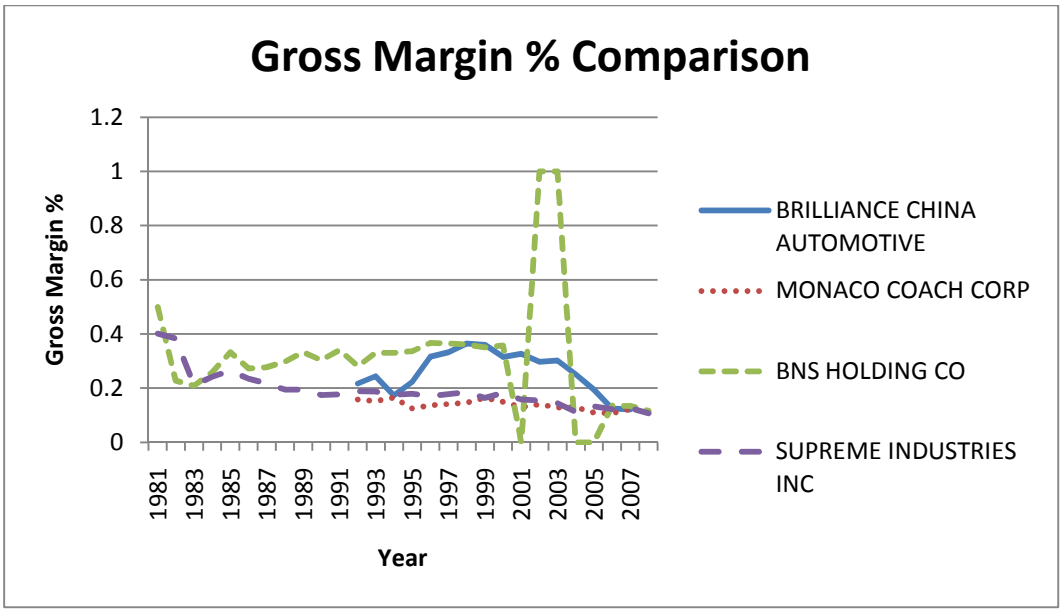

Figure 1-17: Gross Margin % comparison for manufacturer supplier firms.

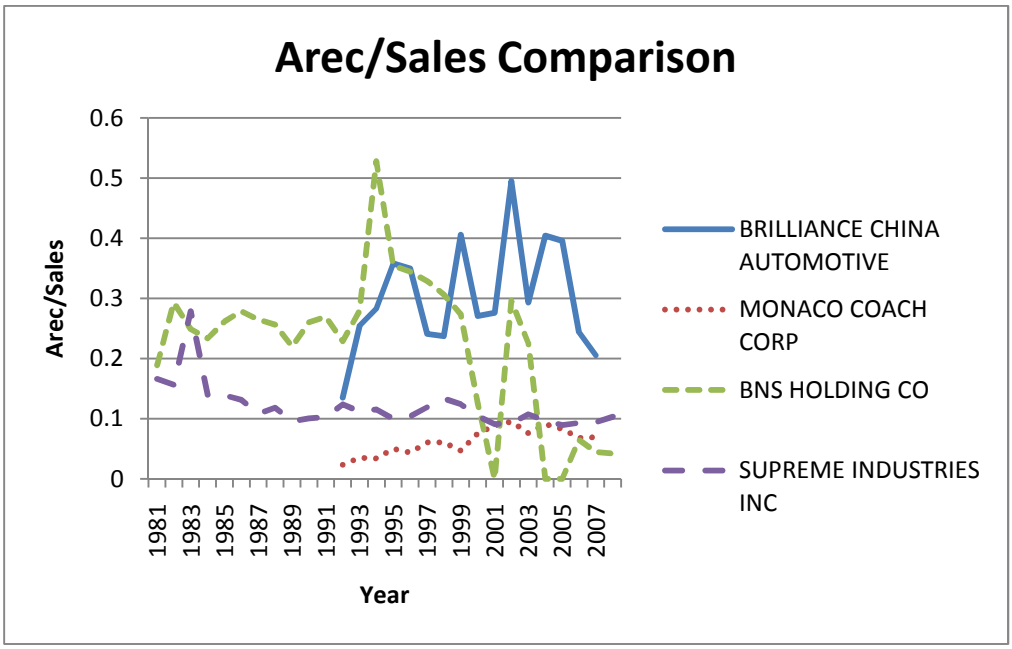

Figure 1-18: Accounts Receivable/Sales comparison for manufacturer supplier firms.

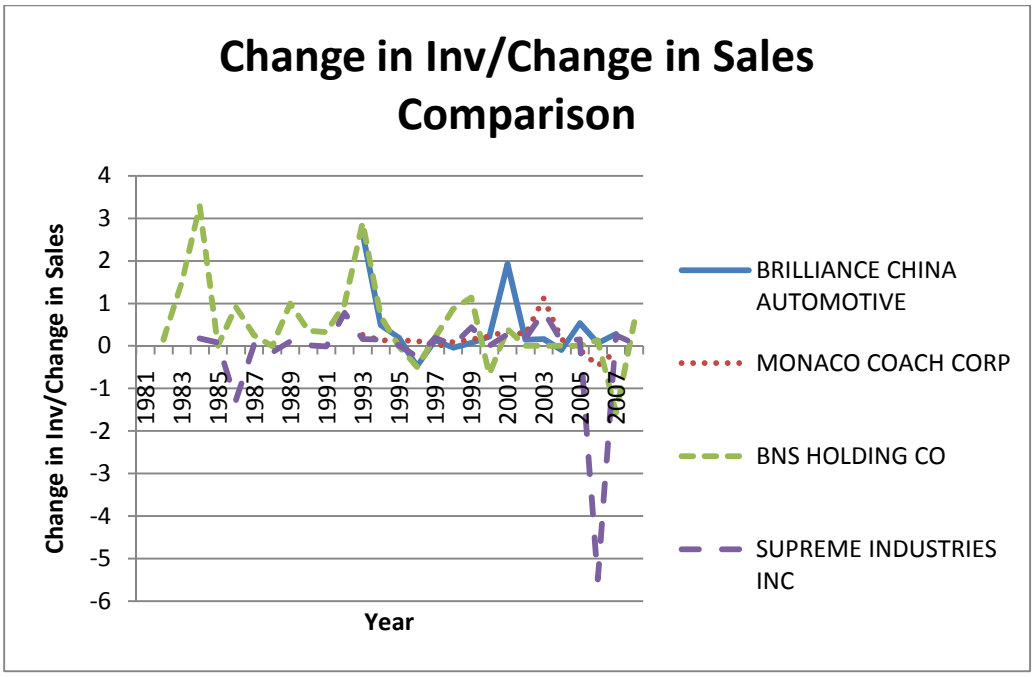

Figure 1-19: Change in Inventory/Change in Sales comparison for manufacturer supplier firms.

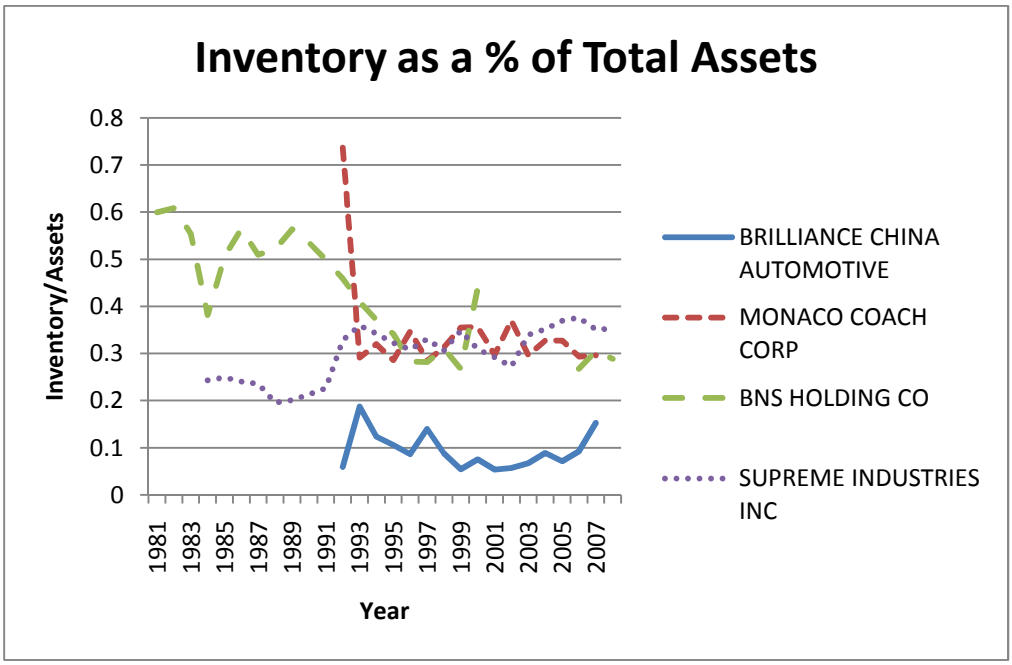

Figure 1-20: Inventory as a percentage of total assets for manufacturer supplier firms (Firm-level analysis).

APPENDIX B

Large Manufacturing Group- Leanness Grouping Analysis

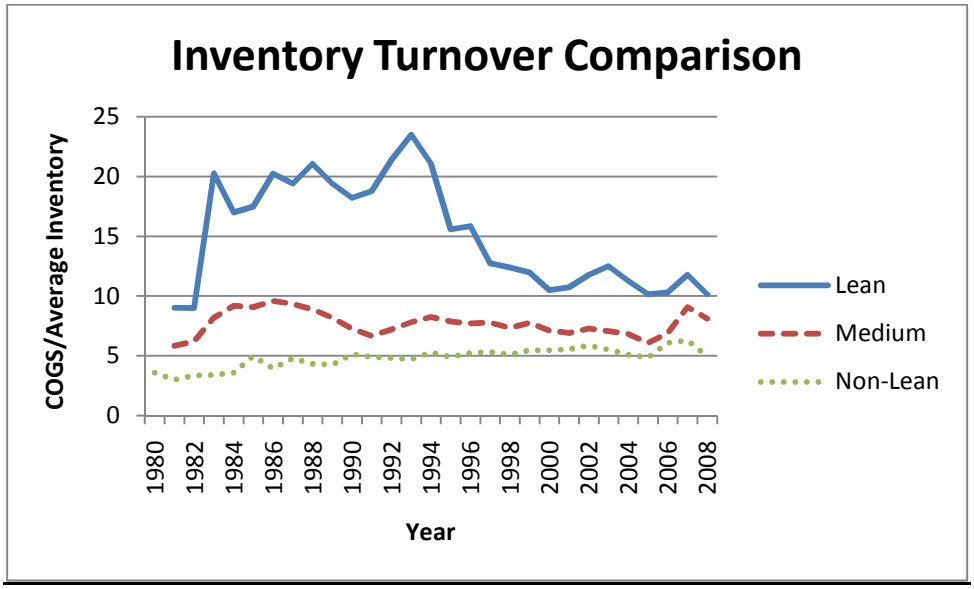

Figure 2-1: Inventory Turnover chart/graph for large manufacturing firms.

Inventory Turnover

	Lean	Medium	Non-Lean
Average	15.12062	7.697725	4.8647
StDev	4.540485	1.009793	0.815877

Inventory Period

	Lean	Medium	Non-Lean
Average	26.68124	49.64586	82.12496
StDev	7.675233	7.212343	14.85747

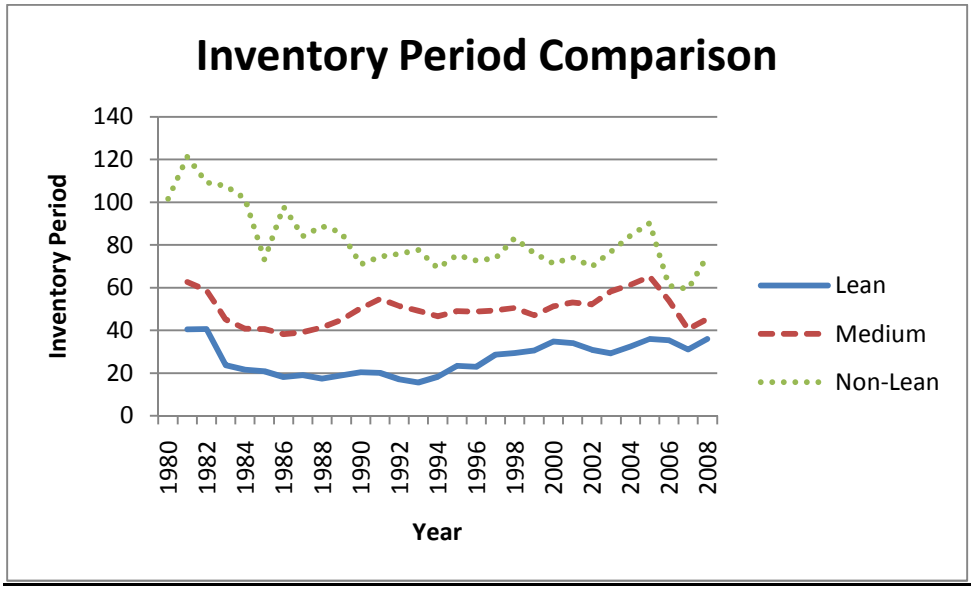

Figure 2-2: Inventory Period chart/graph for large manufacturing firms.

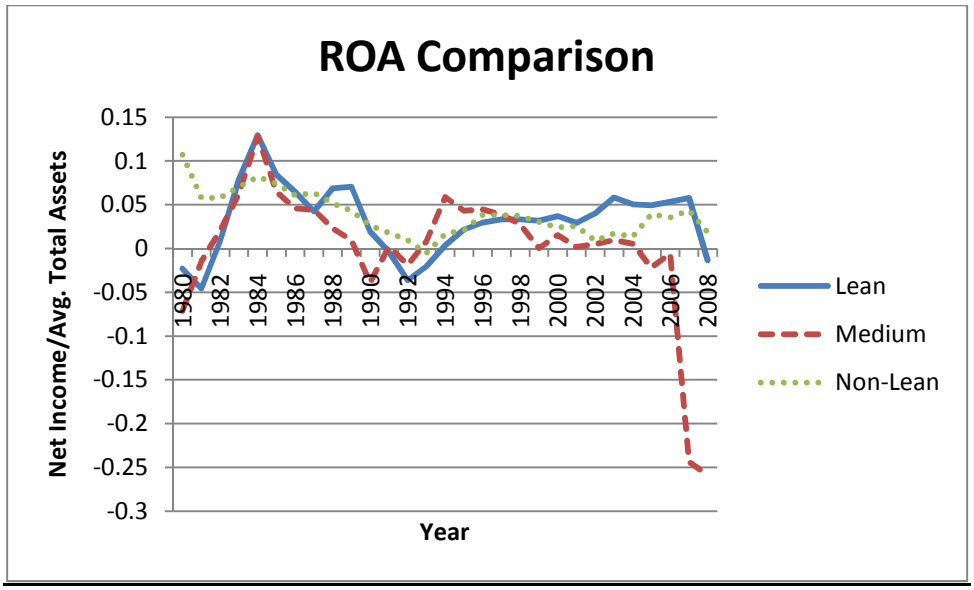

Figure 2-3: Return on Assets chart/graph for large manufacturing firms.

ROA

	Lean	Medium	Non-Lean
Average	0.032819	-0.00054	0.038754
StDev	0.038908	0.078779	0.025291

ROS

	Lean	Medium	Non-Lean
Average	0.030122	0.008358	0.029408
StDev	0.024418	0.048112	0.017255

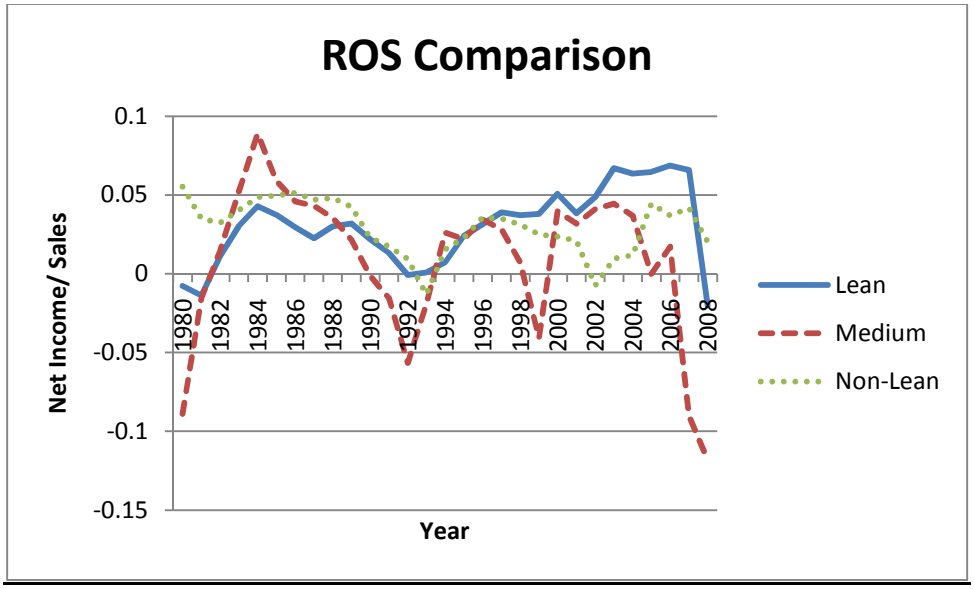

Figure 2-4: Return on Sales chart/graph for large manufacturing firms.

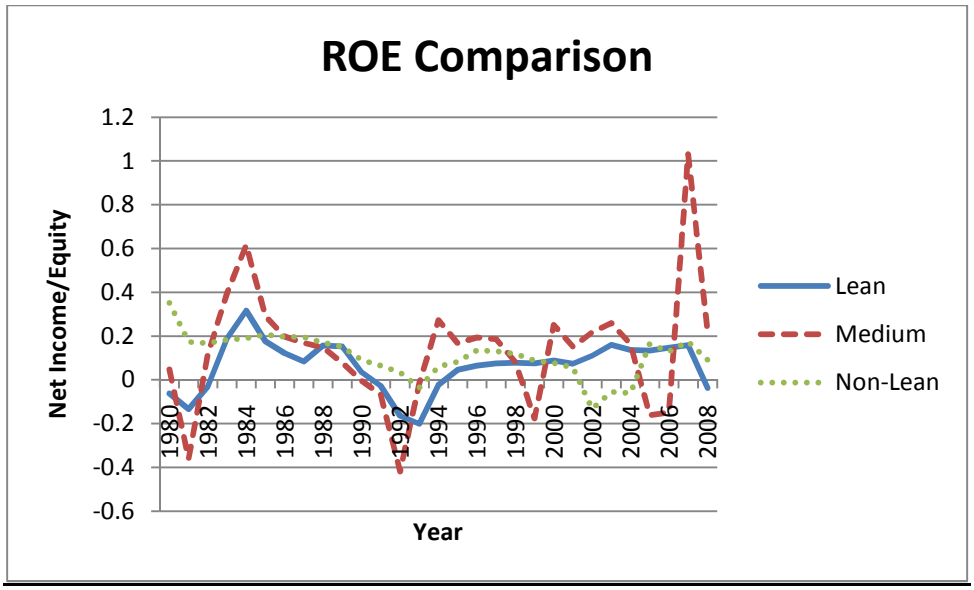

Figure 2-5: Return on Equity chart/graph for large manufacturing firms.

ROE

	Lean	Medium	Non-Lean
Average	0.065331	0.1341	0.110149
StDev	0.1141	0.275031	0.097867

Gross Margin Percentage

	Lean	Medium	Non-Lean
Average	0.180959	0.217154	0.260984
StDev	0.073467	0.062755	0.068563

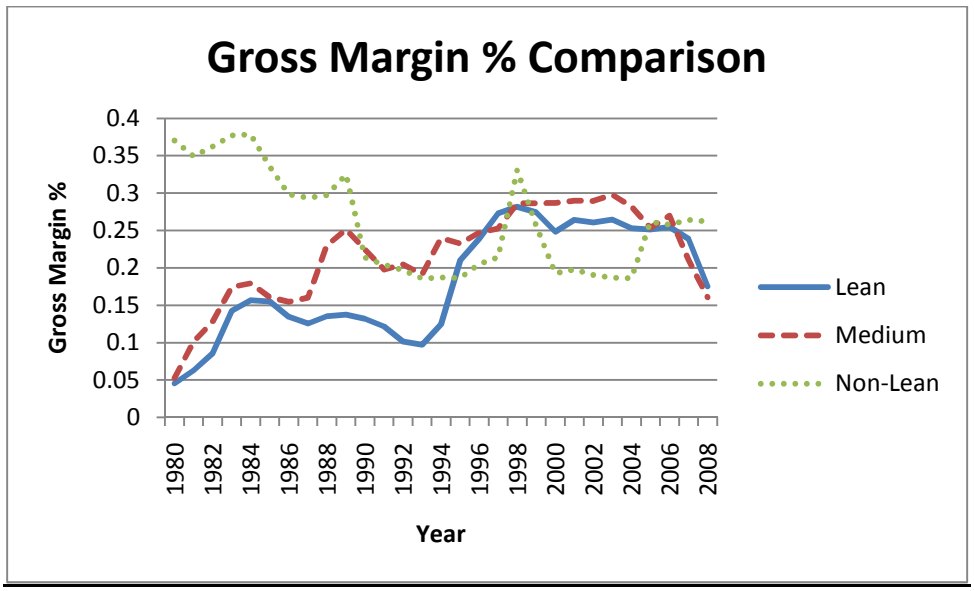

Figure 2-6: Gross Margin percentage chart/graph for large manufacturing firms.

Manufacturer Supplier Group- Leanness Grouping Analysis

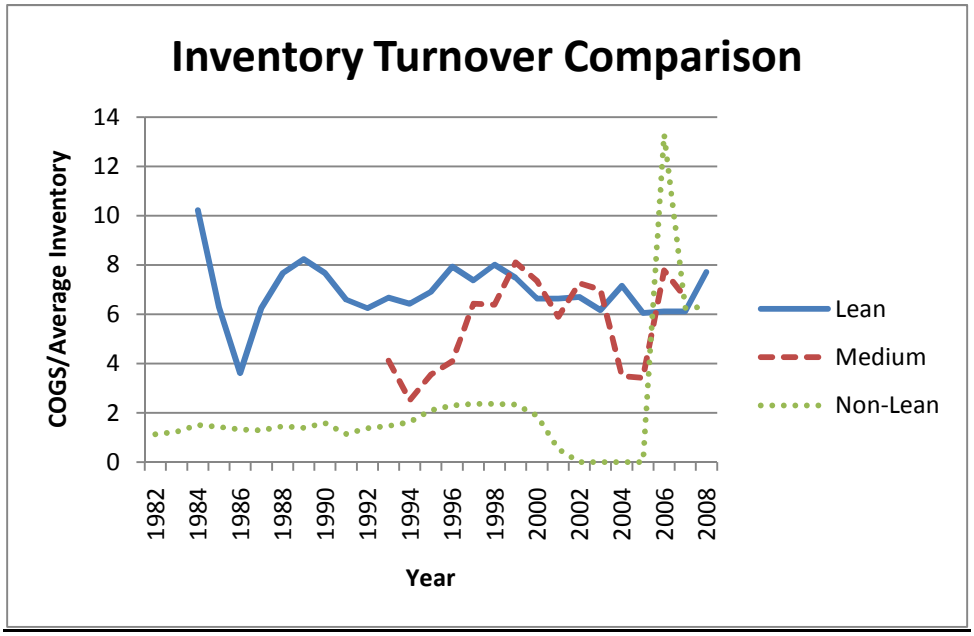

Figure 2-7: Inventory Turnover chart/graph for manufacturing supplier firms.

Inventory Turnover

	Lean	Medium	Non-Lean
Average	6.914806	5.602017	2.137657
StDev	1.165286	1.868195	2.68513

Inventory Period

	Lean	Medium	Non-Lean
Average	55.72552	74.18935	195.8239
StDev	11.55326	30.2031	143.8181

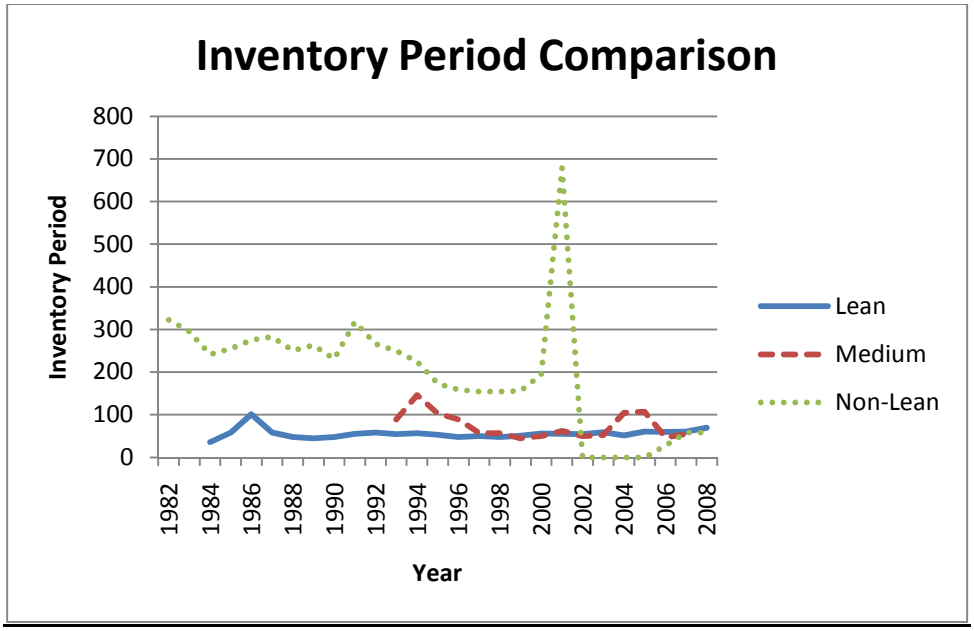

Figure 2-8: Inventory Period chart/graph for manufacturing supplier firms.

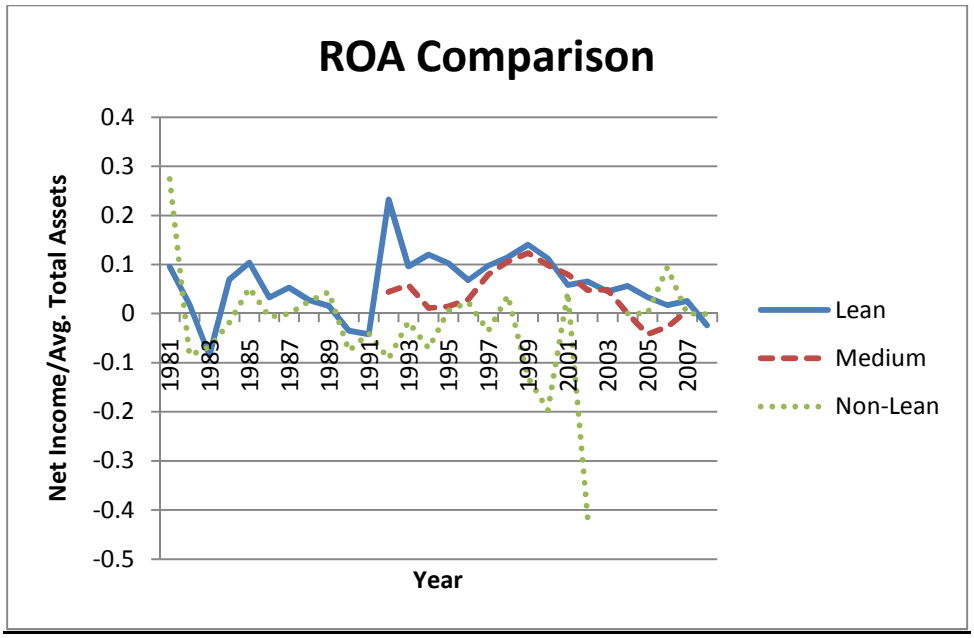

Figure 2-9: Return on Assets chart/graph for manufacturing supplier firms.

ROA			
	Lean	**Medium**	**Non-Lean**
Average	0.057781	0.042354	-0.02422
StDev	0.063912	0.047486	0.114248

ROS			
	Lean	**Medium**	**Non-Lean**
Average	0.018818	0.052499	-0.01678
StDev	0.040826	0.070397	0.077427

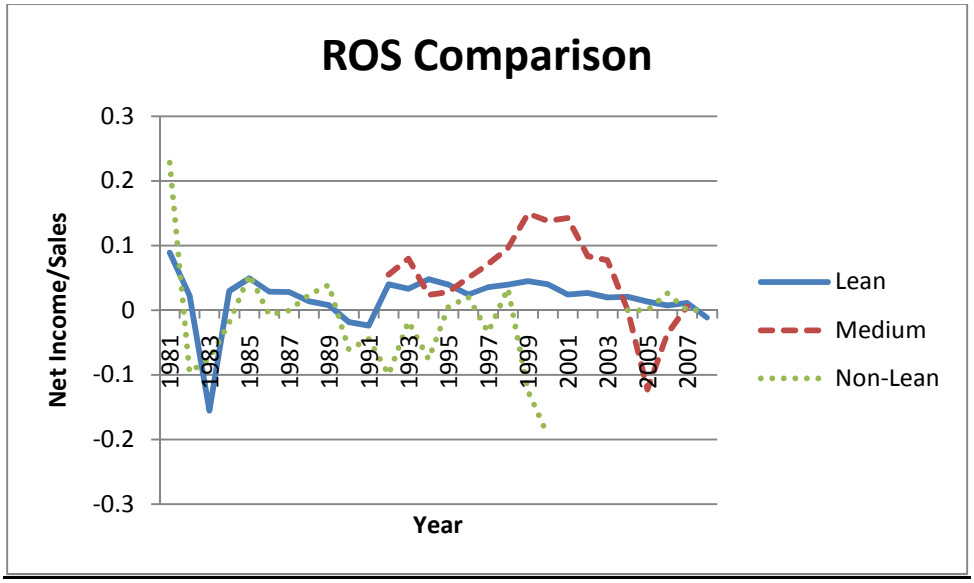

Figure 2-10: Return on Sales chart/graph for manufacturing supplier firms.

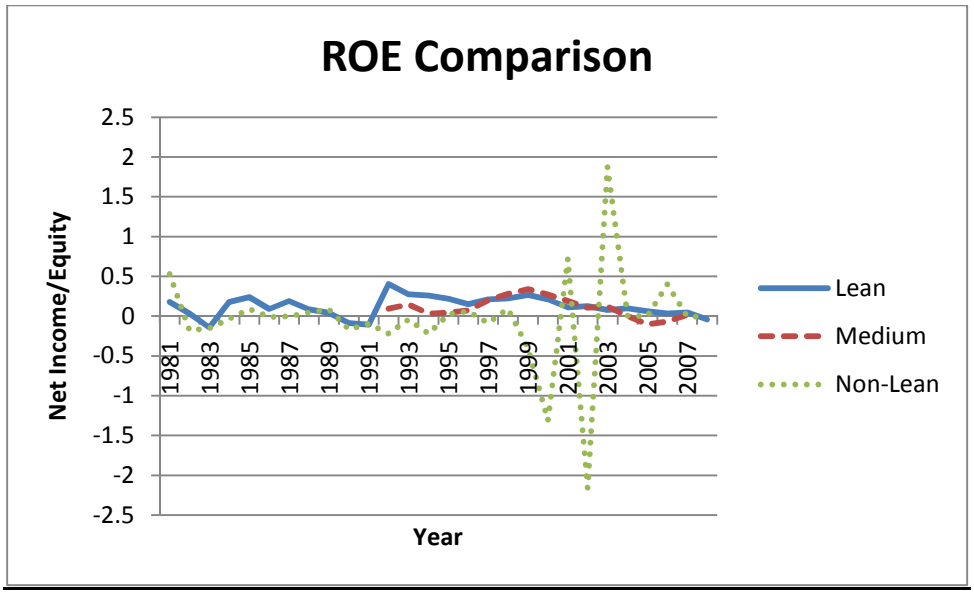

Figure 2-11: Return on Equity chart/graph for manufacturing supplier firms.

ROE

	Lean	Medium	Non-Lean
Average	0.122055	0.108846	-0.0416
StDev	0.126455	0.125094	0.64467

Gross Margin Percentage

	Lean	Medium	Non-Lean
Average	0.185123	0.260069	0.272509
StDev	0.070218	0.078755	0.117504

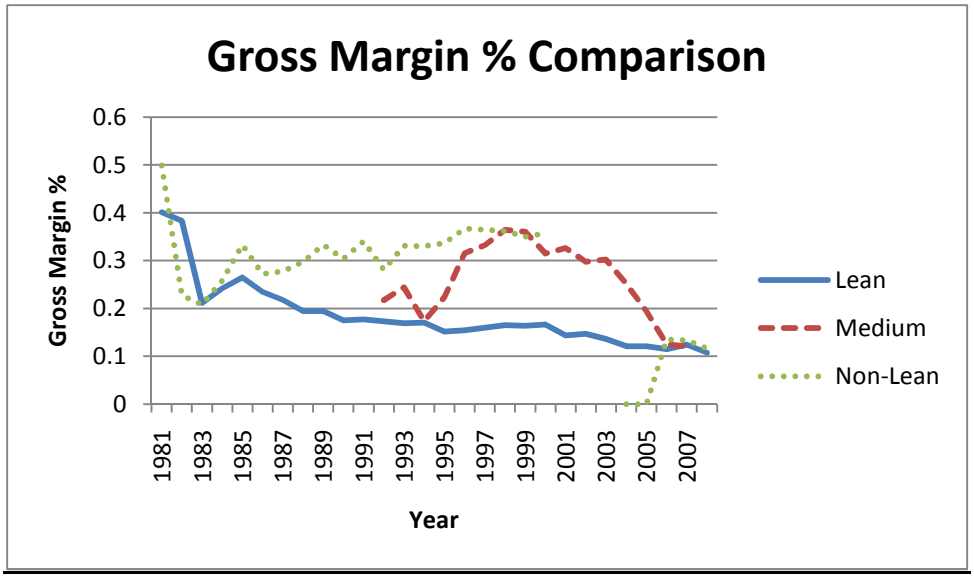

Figure 2-12: Gross Margin % chart/graph for manufacturing supplier firms.

APPENDIX C (DuPont Analysis)

Large Manufacturing Firm Group

Mean				
	ROS	TAT	Leverage	ROE
Lean	0.030122	1.867713	2.665441	0.065331
Medium	0.008358	1.087863	7.962729	0.1341
Non-Lean	0.029408	1.181114	4.038214	0.110149

StDev				
	ROS	TAT	Leverage	ROE
Lean	0.024418	1.054513	0.798414	0.1141
Medium	0.048112	0.48026	7.20662	0.275031
Non-Lean	0.017255	0.323893	1.119277	0.097867

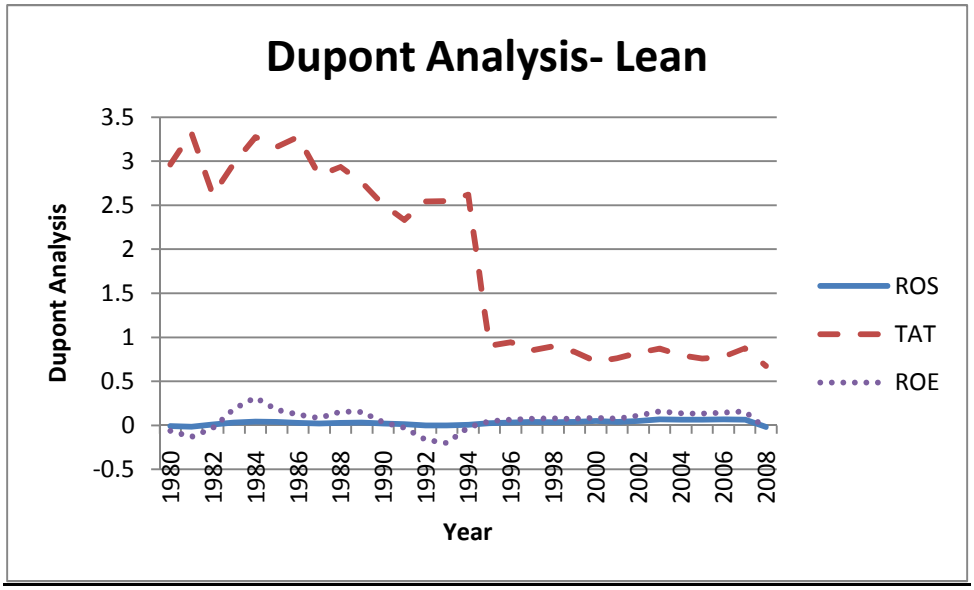

Figure 3-1: DuPont Analysis for Lean Firms.

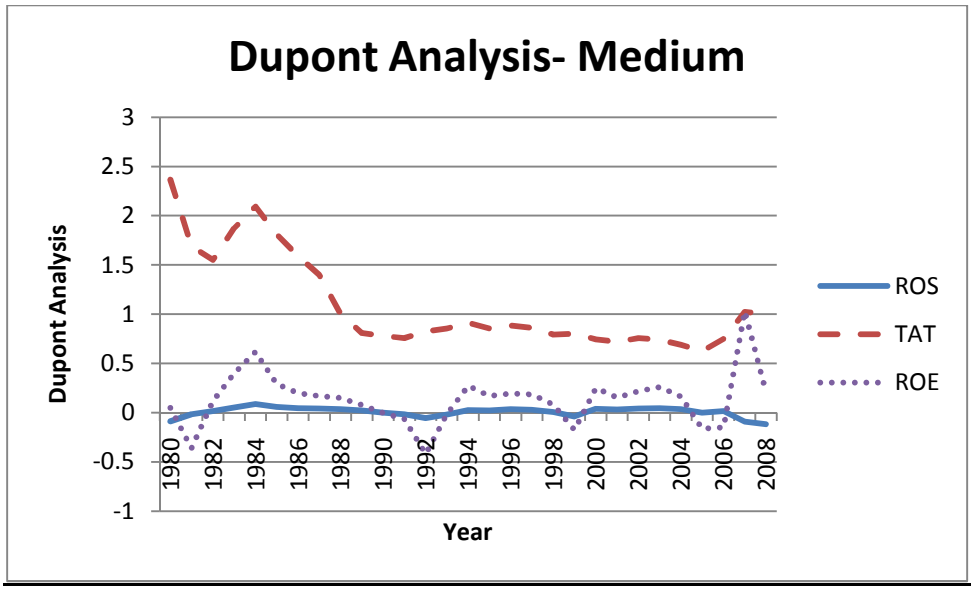

Figure 3-2: DuPont Analysis for Medium Firms.

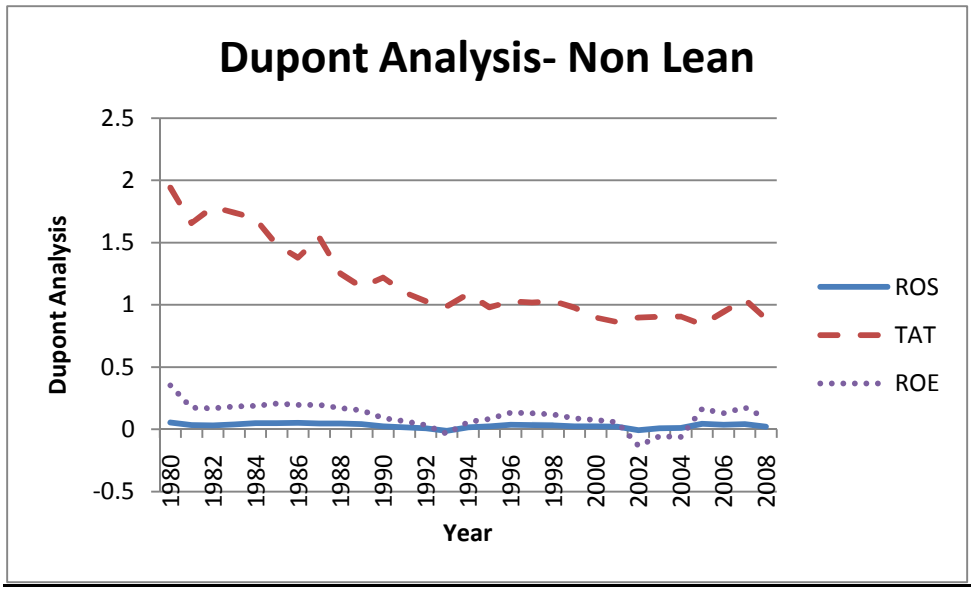

Figure 3-3: DuPont Analysis for Non-Lean Firms.

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